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Cohort Profile: **The Lifelines COVID-19 Cohort: investigating COVID-19 infection and its health and societal impacts in a Dutch population-based cohort**

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Abstract

Purpose: The Lifelines COVID-19 cohort was set up to assess the psychological and societal impacts of the COVID-19 pandemic and investigate potential risk factors for COVID-19 within the Lifelines prospective population cohort.

Participants: Participants were recruited from the 140,000 eligible participants of Lifelines and the Lifelines NEXT birth cohort, who are all residents of the three Northern provinces of the Netherlands. Participants filled out detailed questionnaires about their physical and mental health and experiences on a weekly basis starting in late March 2020, and the cohort consists of everyone who filled in at least one questionnaire in the first eight weeks of the project.

Findings to date: >71,000 unique participants responded to the questionnaires at least once during the first eight weeks, with >22,000 participants responding to seven questionnaires. Compiled questionnaire results are continuously updated and shared with the public through the Corona Barometer website. Early results included a clear signal that younger people living alone were experiencing greater levels of loneliness due to lockdown, and subsequent results showed the easing of anxiety as lockdown was eased in June 2020.

Future plans: Questionnaires were sent on a (bi-)weekly basis starting in May 2020 and on a monthly basis starting July 2020, with plans for new questionnaire rounds to continue through 2020 and early 2021. Questionnaire frequency will increase again if there is a second wave of infections. Cohort data will be used to address how the COVID-19 pandemic develops in the northern provinces of the Netherlands, which environmental and genetic risk factors predict disease susceptibility and severity and the psychological and societal impacts of the crisis. Cohort data is linked to the extensive health, lifestyle and sociodemographic data held for these participants by Lifelines, a 30-year project that started in 2006, and to data about participants held in national databases.

Keywords: COVID-19, population cohort, public health, psychosocial impact, genetics, medication

Strengths and limitations of this study

- The Lifelines COVID-19 cohort collects data about factors relevant to the impact of the COVID-19 pandemic for >70,000 individuals living in the Northern Netherlands. Participants in the cohort are also participants in the Lifelines prospective population cohort and the Lifelines NEXT mother-baby cohorts, which means there is already a rich data background for all participants, and cohort data can be linked to data held in other national databases.
- The cohort questionnaire program began during the height of the first wave of infections in the Netherlands and will continue through late 2020 and early 2021. The questionnaires were designed by a multidisciplinary group of researchers to explore factors that may impact COVID-19 susceptibility and severity and the social, mental and economic impacts of the pandemic.
- The compiled questionnaire data has been continuously shared with the participants and the public through an interactive website, and new questionnaire modules have been added to address questions raised by participants and researchers.
- The region covered by the Lifelines COVID-19 cohort has so far experienced very low numbers of COVID-19 cases, as compared to the rest of the Netherlands. This reduces the power to detect COVID-19-related risk factors but makes the cohort an interesting resource for examining the broader mental health impacts of the governmental measures to slow infection rates and the associated economic slowdown.

Introduction

COVID-19 has now impacted the lives and health of billions of people around the world. Due to the absence of a vaccine, lack of effective antiviral medication and limited understanding of the novel coronavirus SARS-CoV-2, most governments have tried to slow the growth rate of infections through public health measures including tracking and testing, shutting down of public life, social distancing policies and stay-at-home orders. These measures have had a huge impact on public health and well-being, the economy (including employment and working conditions) and daily life. The effects of the COVID-19 pandemic will therefore be multiple: there will be the impact of the infection itself and the broader societal and health impacts.

To identify genetic and environmental risk factors for COVID-19 and address the medical, social and psychological impacts of the pandemic, a multi-disciplinary group of researchers rapidly developed and implemented an extensive COVID-19 questionnaire, leading to the development of the Lifelines COVID-19 cohort. The questionnaire collects data about COVID-19-related symptoms, current health issues and societal impacts from participants recruited from the Lifelines population cohort [1] and the Lifelines NEXT (LLNEXT) birth cohort [2], which are both monitoring the health of the northern Dutch population (provinces of Drenthe, Groningen and Friesland). Via a (bi-)weekly questionnaire, the project gathers information about COVID-19 symptoms, associated comorbidities and environmental factors, changes in work and employment, corona-related worries, loneliness and the mental health and societal impacts of the pandemic. In addition, all participating parents are asked about their children's well-being, and LLNEXT parents received detailed questions about COVID-19-related symptoms expressed by their children. Additional questionnaire modules have been included as the project progressed.

The data collected by the questionnaires is being used to address four aspects of the outbreak: (1) how the COVID-19 pandemic developed in the three northern provinces of the Netherlands, (2) which environmental risk factors predict disease susceptibility and severity, (3) which genetic risk factors

predict disease susceptibility and severity and (4) the psychological and societal impacts of the crisis.

The initial COVID-19 outbreak in the Netherlands and the Northern provinces. The first official COVID-19 cases in the Netherlands were registered on February 27, 2020 [3]. By March 24, 2020, the number of cases diagnosed per day had risen to 1126 (Figure 1B). The rapid rise in case numbers led the Dutch government to shut down primary and secondary schools, bars and restaurants, sporting facilities and other public spaces on March 15, 2020, followed by a more extensive shut-down of public life in the weeks that followed (see Figure 1A for major events). However, the three northern Dutch provinces did not follow national trends. COVID-19 appeared later here and didn't reach the same incidence of cases or infection rates. While the three northern provinces account for 10% of the Dutch population, they only had 2-3% of cases, hospitalizations and deaths in the period from February 27–June 9, 2020 (see Figure 1C; Supplementary table 1). Multiple factors may explain why the outbreak was different in the North [4][5]. Drenthe, Groningen and Friesland together are the least-populated region of the Netherlands and contain the fewest urban centres. The early arrival and spread of infection in the southern Dutch province of North-Brabant seems to have originated in travel to and from Northern Italy during the school holidays from February 22–March 1, 2020, with the spread of the infection in the southern Dutch region then further facilitated by personal contact during regional carnival celebrations. In contrast, school holidays fell earlier for the Northern provinces (February 15–22, 2020), which suggests that northerners who travelled to Italy during the vacation had returned before the major expansion of the outbreak in Northern Italy [6]. Nor is carnival widely or generally celebrated in the Northern provinces. Other factors may also have played a role, e.g. use of a stricter COVID-19 testing regime and wider availability of tests in the region [5]. The later arrival of COVID-19 to the North meant that the national steps taken to bring down the infection rate were in place before the outbreak had really taken hold in the Lifelines region.

Cohort Description

Participant recruitment. Participants of the Lifelines COVID-19 cohort are recruited from the Lifelines and LLNEXT cohorts. Lifelines is a prospective population cohort following ~167,000 people in the three Northern provinces of the Netherlands for 30 years [1] (see Figure 2 for Lifelines region). Established in 2006, Lifelines collects detailed information about its participants via extensive questionnaires and medical examinations, and the cohort has been shown to be representative of the Northern Dutch population [7]. By design, Lifelines recruited multiple participants within families to produce a multi-generational cohort that could map individual and community health across life-course [1]. Since 2016, LLNEXT has been recruiting an additional generation through inclusion of mother-baby pairs, with partners also invited to participate to generate parent-baby trios [2].

To recruit participants for the Lifelines COVID-19 cohort, Lifelines and LLNEXT invited their participants digitally to fill out the questionnaires. In each questionnaire round (Q1-Q7 in Figure 1D, Figure 3), all Lifelines participants over the age of 18 with a known email address received a link to the digital COVID-19 questionnaire (see inclusion flowchart in Figure 3). Digital invitations were valid for three weeks, and the date on which the questionnaire was completed was registered. Since LLNEXT is an ongoing project in which new participants are still being included, the number of LLNEXT participants invited to participate in the COVID-19 cohort increased with each new questionnaire round. In each round, invited participants chose if they want to fill in the questionnaire, and the cohort population consists of all those who filled in at least one questionnaire in the first seven questionnaire rounds (Figure 1D, Figure 3).

On March 30, 2020, all Lifelines and LLNEXT participants were invited to participate in the first COVID-19 questionnaire round (Q1 in Figure 1D, Figure 3), with new invitations to participate sent out weekly. Starting March 27, 2020, an additional questionnaire about children's health and symptoms was sent to the participants of the LLNEXT (>300 participants). Program questionnaires were sent out weekly through the week of May 18, 2020, then at bi-weekly intervals until July 2020, when the questionnaires

became monthly. The project is set to continue through 2020 and early 2021, with the option to increase questionnaire frequency if the local caseload begins to increase rapidly. While the timeline of the questionnaire program will be decided by the outbreak, the cohort itself will continue to exist as part of Lifelines, which will allow participants to be monitored for the long-term health impacts of the pandemic through the length of the Lifelines program.

Questionnaire contents. The Lifelines COVID-19 questionnaire includes question modules about socio-demographic parameters, chronic diseases, COVID-19 infection, general health and symptoms, medication use, the mental health/well-being of participants and of children and young adults in their family, corona-related well-being, social life, social relations and lifestyle (see Table 1 for modules and questions and https://www.lifelines.nl/researcher/data-and-biobank/wiki). For participants who answer a subsequent version of the questionnaire, these questions are related to their experience in the period since the previous questionnaire. Additional questions and question modules have been added as the questionnaire program progressed, including the Groningen Frailty Indicator [8], KIDSCREEN-10 [9] and Positive and Negative Affects Schedule [10].

Lifelines COVID-19 cohort data can be linked to other participant data held by Lifelines, including detailed biological measurements such as genotype, metagenomics, metabolomics and transcriptomics collected for sub-cohorts within Lifelines such as Lifelines DEEP [11] and Lifelines DAG3. Data can also be linked to the administrative records held by Statistics Netherlands (https://www.cbs.nl/en-gb), which include health-related records on mortality, hospital admissions and healthcare costs, as well as data on employment status, income, wealth and other socio-demographic characteristics. Data can also be linked to drug prescription data held by IADB.nl via the Pharmlines initiative [12] and to SARS-CoV-2 testing data (including serological data) held by Certe and other Dutch laboratories.

Participant and public involvement. Projects carried out within Lifelines are discussed with the Lifelines Participant Advisory Board. With respect to the COVID-19 cohort, compiled questionnaire results have been continuously updated after each questionnaire round and shared with participants and the public through interactive infographics on the Corona Barometer website (https://coronabarometer.nl/, snapshot in Figure 4), as well as frequent social media posts, press releases and interviews in the national press. Subsequent questionnaires have also been modified and refined in response to questions from participants. In addition, new questionnaire modules have been added based on the results of previous rounds and to examine the effects of changes in national policy.

Findings to date

Response rates and characteristics of respondents. In every questionnaire round, 139,679 out of 159,482 current adult Lifelines participants are invited to respond to the COVID-19 questionnaire. In all 71,992 (51.4%) Lifelines and LLNEXT participants responded to at least one of the first seven questionnaires, and response rates ranged from 33-39% (42,917-54,525) (Figure 3). Compared to non-invited subjects (those without a known email address), invited subjects are younger, slightly more often female, have a lower BMI and are more often never smokers (Table 2). Of the 139,679 Lifelines participants invited, 71,833 (51%) completed at least one of the questionnaires in the first eight weeks of the programme. Compared to non-responders, these responders were slightly older, slightly more often female, had a higher BMI, were less often current smokers and more often ex-smokers (Table 2). While Lifelines as a whole has been shown to be representative of the regional population [7], these slight differences in cohort make up should be considered when looking at data from the COVID-19 cohort.

For LLNEXT, 321 people were invited to participate in the first eight weeks of the project, and 159 participated (49.5%). Compared to invitees, respondents were more likely to be female (73.5% of respondents versus 50.5% of invitees). As LLNEXT recruits women who are currently pregnant, the age range was small and did not differ substantially between invitees, respondents and non-respondents. In

LLNEXT, 80% of all parents who responded to the main Lifelines COVID-19 questionnaire also returned data on their children for the LLNEXT-specific module on COVID-19 and its impact on children. In total, we have data for 112 children up until week eight of the COVID-19 questionnaire initiative: 96 children 0-3 years of age, 14 children 4-7 years of age and two children in the 8-18 age group.

COVID-19 cases. Of the participants who responded in the first eight weeks of the project, 1,294 (1.8%) responded that they had been tested for COVID-19, and 127 (0.2%) tested positive. In addition, 887 (1.3%) respondents said they had been told by a doctor that they probably had COVID-19, while 5,271 (7.3%) participants responded that they thought they had had COVID-19.

Early results and on-going projects. One of the earliest results of the project was a clear signal that feelings of loneliness and isolation were substantially stronger in individuals who lived alone and that this effect was strongest in the youngest age group of respondents (18-30 year olds, see corresponding panel in Figure 4). There was also an increase in the number of unemployed respondents who reported losing their jobs due to the crisis, rising from 7.5% of unemployed respondents to the first questionnaire round (Q1) up to 14% by the week 5 questionnaire (Q5). More recent results have shown that by the end of May 2020, as the number of infections and hospitalizations dropped to low levels and schools and business reopened, respondents were reporting less anxiety, better sleep and fewer worries about losing their jobs.

The data collected from the Lifelines COVID-19 cohort is currently being analysed to address the four goals of the project. COVID-19 cases reported by participants are being used to track the outbreak, and the symptoms reported by participants are being used to generate a symptom-based COVID-19 prediction model [13]. The data on chronic diseases, medication use and environmental factors (e.g. cohabitation or smoking) will be used to look for associations with SARS-CoV-2 susceptibility and COVID-19 severity, to help identify risk factors, protective factors and comorbidities. While factors such as age,

sex, BMI and certain chronic illnesses have been associated with a more severe COVID-19 and higher mortality [14], there have also been questions about whether recent vaccinations can be protective [15][16], and cohort data should help address this. Important questions about why pregnant women and children seem to be relatively protected will also be analysed. Finally, it will be possible to look at genetic factors in detail as ~18,000 of the 71,922 COVID-19 participants who completed at least one questionnaire have been genotyped through the UMCG Genetics Lifelines Initiative (UGLI). Next steps include identifying participants who were also participants in the Lifelines cohorts for which we have more detailed data, e.g. participants with gut microbiome data, currently available for >10,000 Lifelines participants.

Mental health problems are known to increase in times of physical and psychological distress. The current COVID-19 pandemic is accompanied by strict government measures of social distancing and quarantine. As these events place significant stress on society and increase isolation and loneliness, close monitoring of mental well-being is important for both short- and long-term public health policies and individual-level care. Alertness in clinical systems and tailored mental health care may be needed during and after such a mass traumatic event. The data from the Mini International Neuropsychiatric Interview major depressive disorder and general anxiety disorder [17] modules and the societal impact modules of the questionnaire will allow researchers to i) longitudinally track the prevalence of symptoms and diagnoses of MD and GAD during the pandemic in the Lifelines and LLNEXT populations, ii) associate symptoms with COVID-19 severity and outcome, iii) identify at-risk groups and individuals and iv) measure the impact of government policies on the overall mental health in the cohort.

The questionnaire will also help address the major impact the pandemic has had on the working lives of people in the Netherlands. Healthcare workers are a particularly vulnerable group due to their higher risk of being infected by SARS-CoV-2, and their working conditions during the height of infections included long work hours, cancelled holidays, adverse physical and psychosocial work conditions, i.e.

high psychological and emotional demands and low control [18][19]. These working conditions, together with moral distress in relation to the family situation, may increase the risk for mental health problems and sickness absence in this female-dominated occupational group, with a high baseline risk. Other "essential" occupational groups are experiencing unprecedented changes in their working environments that may affect their physical and mental health as well as their labour market attachment. For many "non-essential" occupational groups that are now encouraged to work from home, the home working environment might not be suitable, and many families now have to combine working from home with caring for children. This will likely impact the productivity and quality of their work and their level of stress.

The lockdown has led to a sudden disruption of the economy, with several economic sectors effectively brought to a standstill. The Lifelines COVID-19 questionnaire is monitoring changes in people's current work situation by asking if they lost their job because of the crisis, if they are working in an essential job, and whether they have to work from home. The answers to these questions will be used to monitor both the impact of the crisis on the short- and longer-term labour market and to identify workers most at risk of losing their job. This is essential information for policymakers to be able to target measures to the most vulnerable groups in society and mitigate the financial impact of the crisis.

Strengths and Limitations

One of the main strengths of this cohort is its embedding within the long-running Lifelines prospective population cohort, which provides a rich data background about participants and the knowledge, infrastructure and relationship with participants necessary to recruit and engage participants during an evolving crisis. The high and sustained rate of response and the weekly questionnaires mean that the cohort can provide a detailed longitudinal prospective view of both the outbreak and the long-term impacts of the crisis. Another strength is the collaboration of researchers across a range of disciplines in designing and implementing a questionnaire that can be used to address a wide range of research

questions, can have immediate impact on policy and can be used to help design new policies to prevent and/or manage renewed outbreaks. Finally, Lifelines will continue to follow its participants for the coming decade and beyond, providing opportunities to examine the long-term health impacts of SARS-CoV-2 infection and of the pandemic.

The Lifelines COVID-19 questionnaire was also designed to make comparisons with similar projects throughout Europe. Direct cross-national comparisons with projects in Denmark and France are possible, as they are using nearly identical questionnaires, and will provide unique opportunities to examine the effects of different governmental measures on mental health and well-being. The cohort is part of COVID-MINDS network of longitudinal studies on the global mental health impact of Covid-19 (https://www.covidminds.org/), and the Lifelines COVID-19 project is also participating in the COVID-19 Host Genetics Initiative [20], an international collaboration to share and analyse data to identify the genetic determinants of SARS-CoV-2 susceptibility, COVID-19 severity and outcomes. In addition, the Lifelines COVID-19 questionnaires have been requested by other (inter)national researchers as basis for designing their own questionnaires, e.g. separate research has been done on the experiences of COVID-19 patients, making use of the Lifelines COVID-19 questions.

The timing and nature of the COVID-19 outbreak in the Northern Netherlands, which diverged from that in other parts of the country, is both a strength and a limitation. The relatively low number of cases in the region, even accounting for undiagnosed cases, may seem to pose difficulties for statistical association analyses looking at COVID-19–related factors. However, >800 participants have had COVID-19, as confirmed by a positive test or a doctor's diagnosis, which permits a wide number of statistical association analyses. Moreover, the impact of the societal steps taken to reduce the rate of infection in more heavily impacted regions of the Netherlands and the impact of the associated economic crises should have similar psychological and social impacts in the Lifelines population. The fact that the

outbreak in the North was effectively capped by public health steps now puts the questionnaire programme in an interesting position to monitor the immediate health and societal impacts of the lockdown measures and the impact of coming out of lockdown. It also lays the groundwork for steps to be taken if there is a resurgence of COVID-19 infections, and the data generated while local infection rates were low could work as baseline values if subsequent outbreaks in the Northern provinces are more intense.

Data sharing

The data analysed in this study was obtained from the Lifelines biobank, under project application number ov20_0554. Researchers interested in using this data should contact the Lifelines Research Office (research@lifelines.nl).

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Conflict of interest

The authors declare no conflict of interest.

Informed consent

All Lifelines and Lifelines NEXT participants have provided informed consent that provides the opportunity for add-on research.

Research involving human participants

Both the Lifelines and the Lifelines NEXT studies were approved by the ethics committee of the University Medical Center Groningen.

Contributorship statement

JD, JOM, HMB and LF conceived and implemented the study. All authors contributed to the design and content of the questionnaire. PL, PD, HW, JMV, APSO, SAJ and RW carried out the data analyses, established the Corona Barometer website and provided all figures and tables. KM drafted the manuscript with contributions from all the authors. All authors reviewed and edited the manuscript. All authors approved the final manuscript.

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Figures

Figure 1. Timeline of the COVID-19 pandemic in the Netherlands and Lifelines data collection. 1A. Important events of the pandemic in the Netherlands from February–June 2020. **1B.** Daily reported positive infections (grey) and hospitalizations (blue) visualized alongside the change in mobility (black) in the Netherlands. Mobility is quantified using Apple Maps Request data (https://www.apple.com/covid19/mobility) with the change over time normalized to February 1, 2020. Change in mobility indicates the percentage change in overall requested driving directions by users of Apple Maps. COVID-19 daily infections and hospitalizations are derived from the CoronaWatchNL github account (https://github.com/J535D165/CoronaWatchNL) and are based on reported numbers from the RIVM. **1C.** The reproductive number in the Netherlands and the three Northern provinces over time. The R(t) is calculated based on incident cases (new positive PCR tests) including healthcare workers and cases appertaining to local outbreaks. National and regional R(t) values in the early phase of the pandemic are not directly comparable, since testing among healthcare workers was more widely adopted early on in the Northern provinces. **1D.** Overview of the Lifelines COVID-19 data collections. The pie chart on the left shows the proportion of participants for each province. The first weekly COVID-19 questionnaire (Q1) was sent out on March 30, 2020. Based on Q1-7, 71,800 unique respondents have filled out at least one questionnaire. From Q7, assessments are biweekly.

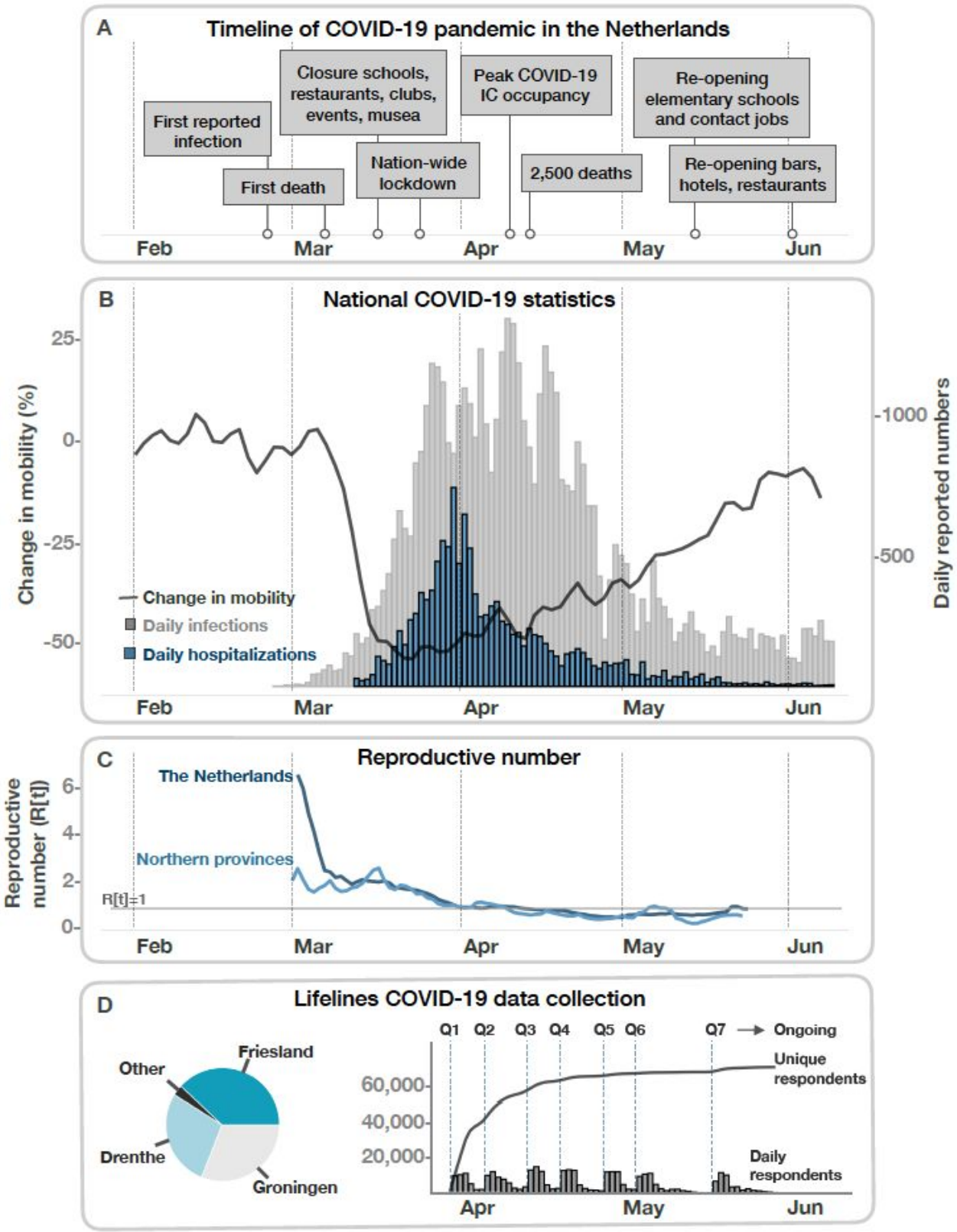


Figure 2. Distribution of hospitalization across Dutch municipalities. The number of hospitalizations per municipality, as reported by the RIVM, were integrated with a geographical map of the Netherlands. For each municipality, the cumulative number of COVID-19 hospitalizations per 100,000 residents is shown. The Lifelines region is outlined in grey. This data was downloaded on May 18, 2020.

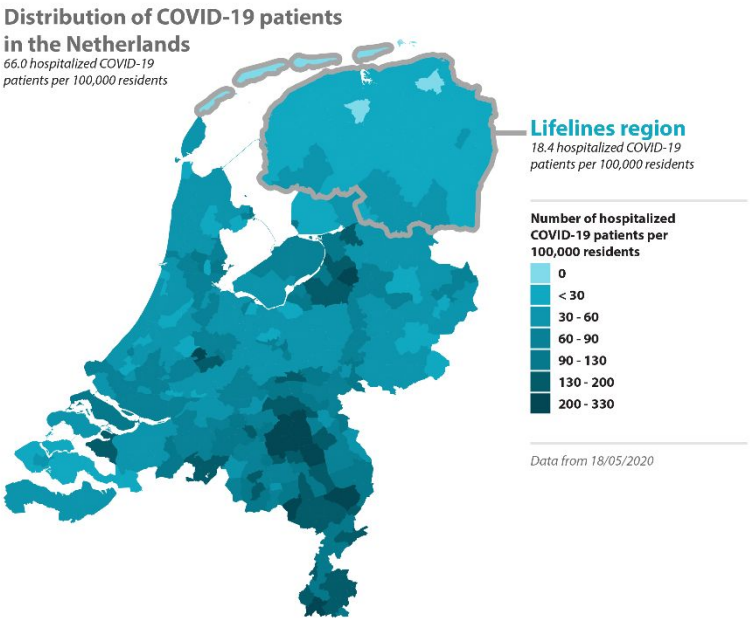


Figure 3. Study inclusion flowchart

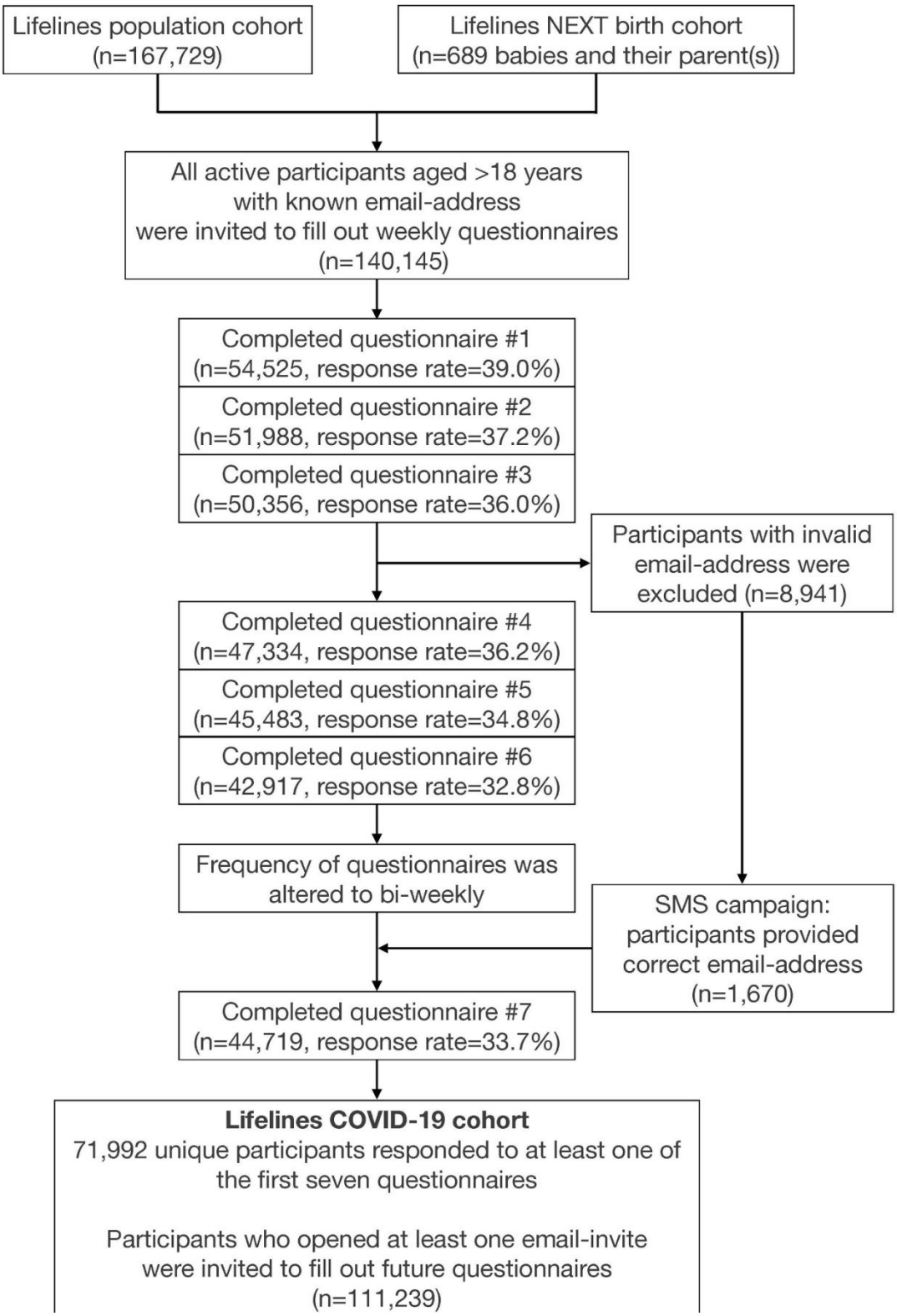
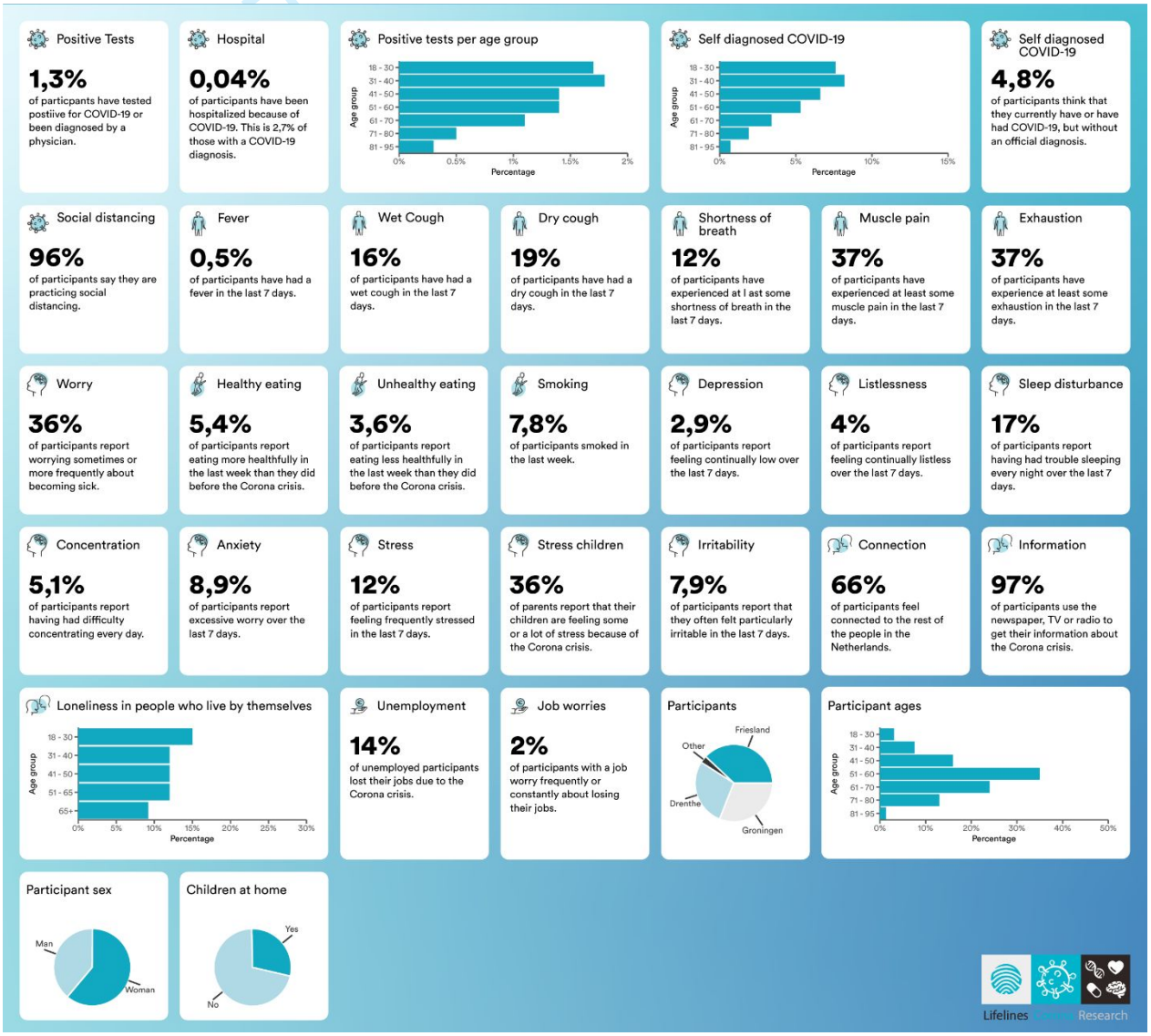


Figure 4. Communicating COVID-19 cohort results to the public through the Coronabarometer.

Snapshot of the Coronabarometer (https://coronabarometer.nl/), which is updated after every questionnaire round to present the most recent findings of the Lifelines COVID-19 questionnaire in a format accessible by the public. The website is now interactive to enable users to look at trends over time and compare variables.



Tables

Table 1. Lifelines COVID-19 questionnaire. Questions asked are modified slightly when respondents have filled in a previous questionnaire to indicate that they should answer with respect to the intervening period.

SOCIO-DEMOGRAPHIC		
Subject	**Question**	**Answer type**
Age	1	In the Lifelines database
Sex	2	In the Lifelines database
Location	3. What are the four numbers of the postcode of your home address?	Numerical field
Living situation	4. The following questions are about your household members who live with you **at least one day a week**.	
	4a1. How many household members are between 0-12 years of age?	Numerical field
	4a2. How many household members are between 13-18 years of age?	Numerical field
	4a3. How many household members are between 18-30 years of age?	Numerical field
	4a3a. How many household members are between 19-30 years of age?	Numerical field
	4a4. How many household members are between 30-59 years of age?	Numerical field
	4a4a. How many household members are between 31-60 years of age?	Numerical field
	4a5. How many household members are older than 60 years of age?	Numerical field
Effects Children	if 4a1 > 0 or 4a2 > 0	
	4b. Are your household members under 19 years of age your children or foster children?	Yes/ No/ Both
	if 4b = 'Yes' or 'Both'	
	4b1. Are your children (or child) experiencing stress about the corona crisis?	No stress / some stress / much stress / a lot of stress
	if 4b1 = 'some stress' or 'much stress' or 'a lot of stress'	
	4b1a. How do they show that?	Text field
	if 4b = 'Yes'	
	4b2. Do your children (or child) feel safe at home?	Safe / somewhat safe / unsafe / very unsafe
	4b3. Do your children (or child) feel safe in their neighbourhood?	Safe / somewhat safe / unsafe / very unsafe

Employment	5. What is your current work situation?	I am a student / I work (full-time, part-time, freelance) / I am disabled / I am unemployed / I am retired
	if 5 = 'I work'	
	5a. What kind of work contract do you have?	Full-time / Part-time / zero hour, flexible, on call / freelance
	5b. What is your current work situation?	I am working from home / I am being paid to work from home / I have been laid off work without pay / I continue to work at the usual location (e.g. office, factory, construction site) / I continue to work at multiple sites for my job / I have been forced to take sick leave or vacation time
	5c. Do you have a critical job? (As defined by the government)	Yes/No
	if 5b = 'I continue to work at the usual location'	
	5d. What is the location of your workplace? (postcode)	Numerical field
	if 5 = 'I am unemployed'	
	5e. Are you unemployed because of the Covid-19 crisis?	Yes/No
	if 5 = 'I work'	
	5f. Since the start of the Corona crisis in NL (mid-March), have you sometimes or regularly worked night shifts?	Yes, regularly / Yes, sometimes / No
	5g. Do you work in a profession in which you still come into frequent contact with patients, clients, children or the general public since the start of the corona crisis in the Netherlands (mid-March)? (For example, nursing, teaching, supermarket staff, police, emergency services etc.)	Yes/No
	4.1 Do you have any other household members? *This applies to anyone who lives with you* ***at least one day a week.***	Yes/No
	if 4a1 or 4a2 or 4a3 or 4a4 or 4a5 > 0	
	4c. Do any of your household members have a critical job? (As defined by the government.)	Yes/No
	4d. Does at least one of your household members work outside the house?	Yes/No
Weight	8a. What is your current weight (in kg)? If you have scale in the house, please weigh yourself.	Numerical field, kg
	8b. At what time of day did you weigh yourself?	morning / evening / I estimated my weight
Vaccinations	9. Did you get a flu shot in the past year?	Yes/No/Don't know
	10. Have you ever been vaccinated against tuberculosis? (BCG)	Yes/No/Don't know
	if 11='Yes'	

10a. What year were you vaccinated against tuberculosis (give an estimate if not sure)?	Numerical field

CHRONIC ILLNESSES		
Subject	**Question**	**Answer Type**
Illness	1. Do you have a chronic health condition?	Yes/No
	1a. Cardiovascular disease (including high blood pressure)	
	1a1. High blood pressure	
	1a1. Heart attack	
	1a1. Narrowing of the arteries in the legs	
	1a1. Stroke or TIA	
	1a1. Other heart and/or coronary disease	
	1b. Lung disease, such as asthma, COPD or chronic bronchitis	
	1c. Liver disease	
	1d. Kidney disease or reduced kidney function	
	1e. Diabetes	
	1f. Chronic muscle disease	
	1g. Psychological illness, such as depression, psychosis or anxiety disorder	
	1h. Auto-immune illness, such as celiac disease, inflammatory bowel disorder, rheumatoid arthritis, lupus	
	1i. Cancer	
	1j. Neurological disease, such as dementia, Parkinson's disease or Alzheimer's disease	
	1k. Problems with your spleen (e.g. sickle cell anaemia, spleen removed)	
	1m. Do you have another kind of chronic condition?	
	1m1. Specify other condition	Text

COVID-19 RELATED	The following questions are about the period since the outbreak of the new corona virus.	
Subject	**Question**	**Answer type**
COVID-19	1a. Have you been tested for coronavirus (COVID-19)?	Yes/No

	if 1a = 'Yes'	
	1a1.Do you have or have you had a coronavirus/COVID-19 infection?	Yes/No
	1a1. What was the result of your corona virus (COVID-19) test?	Positive, I have a corona virus infection (COVID-19)/ Negative, I do not have a corona virus infection (COVID-19)
	if 1a = 'No'	
	1b. Has a doctor told you that you may have (or have had) a Covid-19 infection?	Yes/No
	1c. Do you also think you have (or had) a Covid-19 infection?	Yes/No
	if 1a1='Yes' or 1b ='Yes' of 1c ='Yes'	
	1d. Do you know how you got the infection?	Household family member / other family member / friends / coworkers / sport / other / unknown
	2a. Has someone you live with tested positive for a Covid-19 infection?	Yes/No
	2b. Has someone you live with been told by a doctor that they might have Covid-19?	Yes/No
	2c. Have you had contact with someone who tested positive for Covid-19? This means physical contact rather than by, e.g., telephone.	Yes/Not that I am aware of
	2d. In **the last 14 days** have you had contact with someone who tested positive for Covid-19? This means physical contact rather than by, e.g., telephone.	Yes/Yes, but I am a healthcare professional and used the appropriate personal protection equipment/Not that I am aware of
	2e. **Before filling in the previous questionnaire**, had you had contact with someone who has been diagnosed COVID-19 in the interval between then and now? This person either had symptoms at the time of contact or in the previous 24 hours, or they were diagnosed within a week after contact.	Yes/Yes, but I am a healthcare professional and used the appropriate personal protection equipment/Not that I am aware of
Hospitalization	if 1a1='Yes' or 1b='Yes'	
	3. Have you been hospitalized for a Covid-19 infection?	Yes/No
	Have you been hospitalized for a Covid-19 infection since the last time you filled in the corona virus (COVID-19) questionnaire?	Yes/No
	if 3 = 'Yes'	
	3a. Were you given supplemental oxygen?	Yes/No
	3b. Were you put on antibiotics?	Yes/No
	3c1. Were you in the intensive care unit of the hospital?	Yes/No
	if 3c1 = 'Yes'	

	3c2. Were you put on a ventilator?	Yes/No
HEALTH		
Subject	**Question**	**Answer type**
Overall health	1. How would you rate your health, in general?	excellent / very good / good / medium / poor
Recent symptoms	2. To what degree have you experienced the following symptoms **in the last 7 days:** *(Please fill in these answers even if the symptoms are chronic for you or you think you had them for reasons other than a corona virus infection)*	
	2a. Headache	not at all / a little / some / quite a lot / often
	2b. Dizziness	
	2c. Heart or chest pain	
	2d. Lower back pain	
	2e. Nausea or upset stomach	
	2f. Muscle pain/aches	
	2g. Difficulty breathing	
	2h. Feeling suddenly warm, then suddenly cold again	
	2i. Numbness or tingling somewhere in your body	
	2j. A lump in your throat	
	2k. Part of your body feeling limp	
	2l. A feeling of heaviness in your arms or legs	
	2m. Shortness of breath	
	2n. Pain when breathing	
	2o. Runny nose	
	2p. Sore throat	
	2q. Dry cough	
	2r. Wet cough	
	2s. Fever (38 degrees or higher)	

	2t. Diarrhoea or stomach pain	
	2t1. Diarrhoea	
	2t2. Stomach pain	
	2u. Loss of sense of smell or taste	
	2v. Red, painful or itchy eyes	
	2w. Sneezing	
	2x. Sensitive skin	
	2y. Pain in neck, shoulder(s) or arm(s)	
	2z. Upper back pain	
Fatigue	3. To what degree do you experience the following **in the last 7 days**:	
	3a. I felt tired	7 point NRS with left anchor “Yes, that's correct” and right anchor “No, that's not correct”
	3b. I got tired quickly	
	3c. I felt fine	
	3d. I felt physically exhausted	
Sex	4. Are you a woman between 18 and 55 years of age? *We do have this information in our database, but to ensure the rapid processing of this questionnaire, we are asking you to fill this in again.*	
	if 4=Yes	
Menstruation	4a. Did you menstruate in the last 7 days?	Yes / No / Prefer not to say
Doctor avoidance	5. **In the last 7 days** have you had health problems that you would normally see the doctor for, but chose not to contact your doctor?	Yes/No
	6. What best describes these symptoms?	1=Symptoms I had previously but haven't experience in a while, 2=Intensification of existing symptoms, 3=New symptom(s), 4=New psychological condition, 5=Symptoms fit with a corona infection, 6=Other
	7. Why did you choose not to contact your doctor? More than one answer is possible.	1=Symptoms not bad enough, 2=I got information elsewhere, 3=I started self-treatment, 4=I was anxious about contracting corona, 5=I did not want to bother my doctor, 6=Financial concerns, 7=No time, 8=Other (More than one option is possible)
MEDICATION		

Subject	Question	Answer type
	10. Has your medication usage changed since the last time you filled in the corona questionnaire? Don't forget to think about over-the-counter medications like cough syrup or paracetamol. If you're not sure, click 'Yes'.	Yes/No
	if 10 = Yes	
	Have you taken any medications **in the last 7 days**?	Yes/No
	Which medications have you taken **in the last 7 days**?	
	1. High blood pressure medicine (such as metoprolol, furosemide, enalapril)	Yes/No
	2. Inhaler	Yes/No
	3. Corticosteroids in tablet form (such as prednisone)	Yes/No
	4. Other corticosteroids (such as injections, hormone creams, eye or ear drops)	Yes/No
	5. Cholesterol lowering medication	Yes/No
	6. Diabetes medication	Yes/No
	7. Cough medicine	Yes/No
	8. Pain medication	Yes/No
	9. Other	Text
	if 1 = 'Yes'	
	Which blood pressuring lowering medications (e.g. metoprolol, furosemide, enalapril) have you used **in the last 7 days**? Multiple answers are possible.	Hydrochlorothiazide, Furosemide (e.g. Lasix®), Bumetanide (e.g. Burinex®), Atenolol, Metoprolol (e.g. Selokeen ZOC®), Bisoprolol (e.g. Emcor®), Captopril, Enalapril (e.g. Renitec®), Lisinopril (e.g. Zestril®), Nifedipine
	Other, specifically medicine 1:	Text
	Other, specifically medicine 2:	Text
	if 2 = 'Yes'	
	Which inhalers have you used **in the last 7 days**? Multiple answers are possible.	Salbutamol (e.g. Ventolin®, Airomir®), Formoterol (e.g. Oxis®, Foradil®), Salmeterol (e.g. Serevent®), Ipratropium (e.g. Ipraxa®, Atrovent®), Tiotropium (e.g. Spiriva®), Beclometasone (e.g. Qvar®), Budesonide (e.g. Pulmicort®), Fluticasone (e.g. Flixotide®), Foster®, Symbicort®, Seretide®

Other, specifically medicine 1:	Text
Other, specifically medicine 2:	Text
if 3 = 'Yes'	
Which corticosteroids (such as prednisone) have you used **in the last 7 days**? *Multiple answers are possible.*	Cortisone, Dexamethasone, Hydrocortisone, Prednisolone, Prednisone
Other, specifically medicine 1:	Text
Other, specifically medicine 2:	Text
if 4 = 'Yes'	
Which other corticosteroids (such injections, hormone creams or eye/eardrops) have you used **in the last 7 days**? *Multiple answers are possible.*	Injection with triamcinalonacetonide (e.g. Kenacort-A®), Salve or cream with triamcinolonacetonide, Neusspray met triamcinolonacetonide (e.g. Nasacort®), Eardrops with triamcinolonacetonide, Salve or cream with hydrocortisone, Salve or cream fluticasone (e.g. Cutivate®), Salve or cream with betamethasone, Salve or cream with dexamethasone, Eyedrops with dexamethasone, TriAnal®
Other, specifically medicine 1:	Text
Other, specifically medicine 2:	Text
if 5 = 'Yes'	
Which cholesterol lowering medications have you used **in the last 7 days**? *Multiple answers are possible.*	Simvastatin (e.g. Zocor®), Atorvastatin (e.g. Lipitor®), Fluvastatin (e.g. Lescol®), Rosuvastatin (e.g. Crestor®), Pravastatin, Gemfibrozil (e.g. Lopid®), Cholestyramine (e.g. Questran®), Ezetimib (e.g. Ezetrol®), Inegy®
Other, specifically medicine 1:	Text
Other, specifically medicine 2:	Text
if 6 = 'Yes'	
Which diabetes-related medications have you used **in the last 7 days**? *Multiple answers are possible.*	Insulin (e.g. Novorapid®, Novomix®, Insulatard®, Mixtard®, Lantus®), Metformin, Tolbutamide, Glibenclamide, Gliclazide (e.g. Diamicron®), Pioglitazone (e.g. Actos®), Repaglinide (e.g. NovoNorm®), Acarbose (e.g. Glucobay®), Sitagliptine (e.g. Yesnuvia®)
Other, specifically medicine 1:	Text
Other, specifically medicine 2:	Text
if 7 = 'Yes'	
Which cough medicines have you used in **the last 7 days**? *Multiple answers are possible.*	Codeine, Noscapine, Broomhexine, Althea syrup of thyme syrup, Dextromethorphan, Pentoxyverine, Acetylcysteine, Carbocysteine, Promethazine, Chamomile or menthol

	Other, specifically medicine 1:	Text
	Other, specifically medicine 2:	Text
	if 8 = 'Yes'	
	Which pain killers have you used **in the last 7 days**? *Multiple answers are possible.*	Paracetamol (acetaminophen), Ibuprofen (e.g. Brufen®), Acetylsalicylic acid (e.g. Aspirin®), Diclofenac, Naproxen (e.g. Aleve®), Codeine, Tramadol (e.g. Tramal®), Oxycodone (e.g. OxyContin®, OxyNorm®), Morphine (e.g. MS Contin®, Oramorph®)
	Other, specifically medicine 1:	Text
	Other, specifically medicine 2:	Text
	if 9 = 'Yes'	
	9a. How many other different medicines have you used **in the last 7 days**? (*maximum 10*)	Text

MENTAL HEALTH AND WELL-BEING

Subject	Question	Answer type
MINI - Depression	1. In **the last 7 days** have you felt low or depressed for much of the day, every day?	Yes/No
	2. In **the last 7 days** have you had the feeling that you've lost interest in or the will to do things you are normally interested in?	Yes/No
	3. The following questions are about your experience in **the last 7 days**:	
	3a. Did your appetite change noticeably, or did your weight increase or decrease without this being intended?	Yes/No
	3b. Have you had problems sleeping almost every night (difficulty falling asleep, waking up in the night or too early in the morning, or actually sleeping too much)?	Yes/No
	3c. Did you speak or move more slowly than normal? Or did you feel restless, jittery and could barely sit still? Nearly every day?	Yes/No
	3d. Did you feel worthless or guilty almost every day?	Yes/No
	3e. Was it difficult to concentrate or make decisions almost every day?	Yes/No
	3f. Have you considered hurting yourself, wished you were dead, or had suicidal thoughts?	Yes/No
MINI - Anxiety	4. In **the last 7 days**, have you been worrying excessively and worrying about multiple problems of everyday life, at work, at home, in your immediate environment?	Yes/No
	if 4='Yes'	
	4a. Were these worries present almost every day **in the last 7 days**?	Yes/No
	4b. **In the last 7 days** did you find it hard to set these worries aside or did they prevent you from concentrating?	Yes/No

	5. **In the last 7 days** did it often happen that…	
	5a. You felt restless, jittery or nervous?	Yes/No
	5b. You felt tense?	Yes/No
	5c. You were particularly irritable?	Yes/No
CORONA RELATED WELL-BEING		
Subject	**Question**	**Answer type**
Pandemic worries	1. How much have you been concerned about the corona crisis in the past 7 days?	1=not concerned, 10=extremely concerned
	2a. I worry about getting sick myself	Never / almost never / sometimes / frequently
	2b. I worry that someone close to me will get sick	/ always or almost always
	2c. I am concerned that I or my family will be in serious financial trouble	
	2d. I worry that I will lose my job	
	2e. I worry that it will be a long time before my life returns to normal	
	2f. I am concerned that I can't see friends and family	
	2g. I am worried for another reason	
	if 2g = 'sometimes/frequently/always or almost always'	
	2g. For what other reason are you worried?	Text
Infection precautions	3. What precautions are you taking to prevent the spread of the coronavirus?	Frequent hand washing / Use of hand disinfectant / Social distancing (except for household members) / Social distancing, including household members / Covering my mouth and nose in public / Avoiding public transport / Reduced travel / Other, specifically...
	if 3 = 'Other, specifically...'	
	3_txt. What other precautions are you taking to prevent the spread of the coronavirus?	Text
Information sources	4. Where have you been getting your information and advice from **in the last 7 days**?	Media (Newspaper, TV, radio) / Health authorities (e.g. government, RIVM, WHO) / Social media (e.g. Facebook, twitter, instagram) / Family and friends / Others
	if 4 = 'Others, specifically...'	

	4_txt. Where else have you been getting your information and advice from **in the last 7 days**?	Text
Perceptions	5. Covid-19 threatens everyone in the Netherlands. 6. Since the beginning of the Covid-19 crisis, I see others in my area, such as people in the neighbourhood or in shops, as a threat to my well-being. 7. I have faith in the Dutch government's response to the corona crisis.	1=totally disagree, 2=disagree slightly, 3=neutral, 4=agree slightly, 5=totally agree
Corona proximity	8. Does someone close to you have a Covid-19 infection?	Yes/No
	9. Has someone close to you died of a Covid-19 infection?	Yes/No
Quality of life	10. How would you rate your quality of life **over the last 7 days**?	1= terrible, 10=excellent

SOCIAL LIFE

Subject	**Question**	**Answer types**
Social isolation	1. How socially isolated have you felt **in the last 7 days**?	1=not socially isolated, 10=extremely socially isolated
Loneliness	2. Can you tell us about how you felt **in the last 7 days?**	
	2a. How often do you feel excluded?	Almost never or never/ sometimes/ often
	2b. How often do you feel isolated from others?	Almost never or never/ sometimes/ often
	2c. How often do you feel alone?	Almost never or never/ sometimes/ often

SOCIAL RELATIONS

Subject	**Question**	**Answer type**
	Can you indicate how much you agreed with the statements below **in the last 7 days**?	
	1. I feel connected to all Dutch people	1=totally disagree, 2=disagree slightly, 3=neutral, 4=agree slightly, 5=totally agree
	2. I feel connected to my neighbours, family and/or friends	
	3. I get the help and support I need from my neighbours, family and/or friends	
	4. I do everything I can to help others who are infected with Covid-19	
	5. I expect that others will do everything they can to help me if I get infected or ill with Covid-19	
	6. I do not feel obliged to comply with the government's corona measures	
	7. I feel excluded by society	

	8. I feel that I am not appreciated by others in society	
	9. I am frustrated with how things are now going in society	1=absolutely not, 7=very much
	10. I am afraid that things will go wrong in our society	1=absolutely not, 7=very much

LIFESTYLE CHANGES		
Subject	**Question**	**Answer types**
Eating patterns	1. How healthy are you eating compared to the period before the Covid-19 crisis?	1=Much less healthy, 2=less healthy, 3=just as healthy, 4=healthier, 5=much healthier
	2. How often do you eat per day?	1=Less than 3x per day, 2=3x per day, 3=4x per day, 4=5x per day, 5=6x per day, 6=7x per day, 7=8x per day, 8=more than 8x per day
	3. How important do you think healthy eating is compared to the period before the Covid-19 crisis?	1=Much less important, 2=Less important, 3=Just as important, 4=More important, 5=Very important
Exercise	4. Before the corona crisis, how many minutes of (relatively) intense activity did you do each week (e.g. walking, biking or running)?	1=less than 50 mins, 2= 50-100 mins, 3=100-150 mins, 4= 150 -180 mins, 5= more than 180 minutes
	5. In the last **7 days**, how many minutes of (relatively) intense activity did you do (e.g. walking, biking or running)?	1=less than 50 mins, 2= 50-100 mins, 3=100-150 mins, 4= 150 -180 mins, 5= more than 180 minutes
	6. I do muscle and bone strengthening exercises, such as Nordic walking, jumping rope or weight training:	1=More than in the period before the Covid-19 crisis, 2=Just as much as in the period before the Covid-19 crisis, 3=Less than in the period before the Covid-19 crisis
Smoking	7. Have you smoked in the last 7 days?	Yes/No
Alcohol	8. Have you drunk alcohol in the last 7 days? If yes, how many units, on average?	0=0, 1=1 glass or "once',' 2=2 glasses, 3=3 glasses, 4=4 glasses, 5=5 glasses, 6=6 or more glasses
	8a. How many units of alcohol have you consumed in the last 7 days?	0=0, 1=1 glass or "once',' 2=2 glasses, 3=3 glasses, 4=4 glasses, 5=5 glasses, 6=6 or more glasses
	8b. How many units of alcohol have you consumed in the last 7 days total?	Fill in number, greater than 0, warning by 50
Activity levels	9. Before the corona crisis, how much time did you spend sitting, on average, per **working day** (Monday to Friday)?	Don't know, less than 1 hour, 1 hour, …, 12 hours, more than 12 hours
	10. Before the corona crisis, how much time did you spend sitting, on average, per **weekend day** (Sat, Sun)?	Don't know, less than 1 hour, 1 hour, …, 12 hours, more than 12 hours
	11. In the past 7 days, how much time did you spend sitting, on average, per **working day** (Monday to Friday)?	Don't know, less than 1 hour, 1 hour, …, 12 hours, more than 12 hours
	12. In the past 7 days, how much time did you spend sitting on average per **weekend day** (Sat, Sun)?	Don't know, less than 1 hour, 1 hour, …, 12 hours, more than 12 hours

COMMENTS	
Question	**Answer type**

1. Do you have any comments regarding this questionnaire?	Yes/No
if 1=Yes	
1_txt. What comments do you have about this questionnaire?	Text

GRONINGEN FRAILTY INDEX	For respondents 65 years of age and older.
Question	**Answer type**
1. Are you 65 or older? We do have this information in our database, but to ensure the rapid processing of this questionnaire, we are asking you to fill this in again.	Yes/No
2. Can you independently perform the following activities without any help from someone else, possibly with the help of a cane, walker or wheelchair?	Yes/No
2a. Get groceries and run errands	Yes/No
2b. Get dressed/undressed	Yes/No
2c. Move outdoors (around house, to neighbours)	Yes/No
2d. Go the toilet	Yes/No
3. What score would give your fitness (from 0 to 10):	Scale from 0 to 10
4. Do you have problems in everyday life due to poor vision?	Yes, many problems / Yes, some problems / No, no problems
5. Do you have problems in everyday life due to poor hearing?	Yes, many problems / Yes, some problems / No, no problems
6. Have you lost a lot of weight in the past period without wanting to (6 kg in 6 months or 3 kg in one month)?	Yes/No
7. Do you have memory problems?	No/Sometimes/Yes

KIDSCREEN	If household members are <18 years old (questions from the socio-demographic module).
Question	**Answer type**
How old is your oldest child aged 18 years or younger?	Number
Complete the following questions for this child for **the last 7 days**:	
1. Has your child felt fit and healthy?	Never / almost never / sometimes / frequently / always
2. Has your child felt full of energy?	

3. Has your child felt sad?

4. Has your child felt lonely?

5. Has your child had sufficient time for him or herself?

6. Has your child been able to do the things her or she wanted to do in their free time?

7.Has your child felt that he or she has been treated fairly by his/her parents?

8. Did your child have fun with his/her friends?

9. Did school activities go well?

10a. Has your child been able to pay attention?

10b. Has your child felt anxious?

10c. Has your child felt angry?

10d. Has your child been bored?

11. In general, how would your child rate his/her health? Excellent / very good / good / fair / poor

Table 2. Characteristics of adult Lifelines participants invited to participate in the cohort and the participants in COVID-19 questionnaire cohort during the first eight weeks of the project (Questionnaire rounds 1-7).

	Invited	Not invited	P-value	Responded	Not Responded	P-value
N (%)	139,679 (87.6)	19,803 (12.4)		71,833 (51.4)	67,846 (48.6)	
Current age, mean (sd)	51.1 (13.6)	57.8 (18.3)	< 0.01	54.1 (12.9)	47.9 (13.6)	< 0.01
Male sex, %	41.6	42.3	0.08	39.2	44.2	< 0.01
BMI at last visit, mean (sd)	25.9 (4.3)	26.5 (4.9)	< 0.01	26.0 (4.3)	25.8 (4.4)	< 0.01
Smoking at last visit, %						
never	52.1	46.1		51.8	52.6	
ex	32.1	37.4	< 0.01	34.0	28.6	< 0.01
current	15.8	16.5		14.2	18.8	

Table 3. Characteristics of Lifelines NEXT participants invited to participate in the cohort and the participants in COVID-19 questionnaire cohort during the first eight weeks of the project (Questionnaire rounds 1-7).

	Invited	Responded	Not responded	P-value
N (%)	321 (100)	159 (49.5)	162 (50.5)	
Current age, mean (sd)	33.6 (4.9)	33.0 (4.3)	34.3 (5.3)	0.01
Male sex, %	49.5	36.5	62.3	< 0.01

Supplementary Table 1. Populations and COVID-19 infections, hospitalizations and deaths for the Netherlands as whole and for the Northern Provinces. Population values are as of January 1, 2020, retrieved from the Central Bureau Statistiek (https://opendata.cbs.nl/#/CBS/nl/dataset/03759ned/table; accessed July 10, 2020). COVID-19 statistics are as of June 09, 2020. Source: RIVM, downloaded from the CoronaWatchNL Github.

Region	Population	Infections	Hospitalizations	Deaths
Netherlands	17,181,084	47,903	11,800	6,031
North NL	1,729,505	1,491	320	122
Groningen	585,866	352	74	17
Friesland	493,682	616	130	65
Drenthe	649,957	523	116	40

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Cohort Profile: The Lifelines COVID-19 Cohort: investigating COVID-19 infection and its health and societal impacts in a Dutch population-based cohort

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Cohort Profile: **The Lifelines COVID-19 Cohort: investigating COVID-19 infection and its health and societal impacts in a Dutch population-based cohort**

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Abstract

Purpose: The Lifelines COVID-19 cohort was set up to assess the psychological and societal impacts of the COVID-19 pandemic and investigate potential risk factors for COVID-19 within the Lifelines prospective population cohort.

Participants: Participants were recruited from the 140,000 eligible participants of Lifelines and the Lifelines NEXT birth cohort, who are all residents of the three Northern provinces of the Netherlands. Participants filled out detailed questionnaires about their physical and mental health and experiences on a weekly basis starting in late March 2020, and the cohort consists of everyone who filled in at least one questionnaire in the first eight weeks of the project.

Findings to date: >71,000 unique participants responded to the questionnaires at least once during the first eight weeks, with >22,000 participants responding to seven questionnaires. Compiled questionnaire results are continuously updated and shared with the public through the Corona Barometer website. Early results included a clear signal that younger people living alone were experiencing greater levels of loneliness due to lockdown, and subsequent results showed the easing of anxiety as lockdown was eased in June 2020.

Future plans: Questionnaires were sent on a (bi-)weekly basis starting in March 2020 and on a monthly basis starting July 2020, with plans for new questionnaire rounds to continue through 2020 and early 2021. Questionnaire frequency can be increased again for subsequent waves of infections. Cohort data will be used to address how the COVID-19 pandemic developed in the northern provinces of the Netherlands, which environmental and genetic risk factors predict disease susceptibility and severity and the psychological and societal impacts of the crisis. Cohort data is linked to the extensive health, lifestyle and sociodemographic data held for these participants by

Lifelines, a 30-year project that started in 2006, and to data about participants held in national databases.

Keywords: COVID-19, population cohort, public health, psychosocial impact, genetics, medication

Strengths and limitations of this study

- The Lifelines COVID-19 cohort collects data about factors relevant to the impact of the COVID-19 pandemic for >70,000 individuals living in the Northern Netherlands. Participants in the cohort are also participants in the Lifelines prospective population cohort and the Lifelines NEXT mother-baby cohort, which means there is already a rich data background for all participants, and cohort data can be linked to data held in other national databases.
- The cohort questionnaire program began during the height of the first wave of infections in the Netherlands and continued through late 2020 and early 2021. The questionnaires were designed by a multidisciplinary group of researchers to explore factors that may impact COVID-19 susceptibility and severity and the social, mental and economic impacts of the pandemic.
- The compiled questionnaire data has been continuously shared with the participants and the public through an interactive website, and new questionnaire modules have been added to address questions raised by participants and researchers.
- The region covered by the Lifelines COVID-19 cohort has so far experienced very low numbers of COVID-19 cases, as compared to the rest of the Netherlands. This reduces the power to detect COVID-19-related risk factors but makes the cohort an interesting resource for examining the broader mental health impacts of the governmental measures to slow infection rates and the associated economic slowdown.

Introduction

COVID-19 has now impacted the lives and health of billions of people around the world. Due to the initial absence of a vaccine, lack of effective antiviral medication and limited understanding of the novel coronavirus SARS-CoV-2, most governments have tried to slow the growth rate of infections through public health measures including tracking and testing, shutting down of public life, social distancing policies and stay-at-home orders. These measures have had a huge impact on public health and well-being, the economy (including employment and working conditions) and daily life. The effects of the COVID-19 pandemic will therefore be multiple: there will be the impact of the infection itself and the broader societal and health impacts.

To identify genetic and environmental risk factors for COVID-19 and address the medical, social and psychological impacts of the pandemic, a multi-disciplinary group of researchers rapidly developed and implemented an extensive COVID-19 questionnaire, leading to the development of the Lifelines COVID-19 cohort. The questionnaire collects data about COVID-19-related symptoms, current health issues and societal impacts from participants recruited from the Lifelines population cohort [1] and the Lifelines NEXT (LLNEXT) birth cohort [2], which are both monitoring the health of the northern Dutch population (provinces of Drenthe, Groningen and Friesland). Via a (bi-)weekly questionnaire, the project gathers information about COVID-19 symptoms, associated comorbidities and environmental factors, changes in work and employment, corona-related worries, loneliness and the mental health and societal impacts of the pandemic. In addition, all participating parents are asked about their children's well-being, and LLNEXT parents received detailed questions about COVID-19-related symptoms expressed by their children. Additional questionnaire modules have been included as the project progressed.

The data collected by the questionnaires is being used to address four aspects of the outbreak: (1) how the COVID-19 pandemic developed in the three northern provinces of the Netherlands, (2) which environmental risk factors predict disease susceptibility and severity, (3) which genetic risk factors

predict disease susceptibility and severity and (4) the psychological and societal impacts of the crisis.

The initial COVID-19 outbreak in the Netherlands and the Northern provinces. The first official COVID-19 cases in the Netherlands were registered on February 27, 2020 (see timeline Figure 1A) [3]. By March 24, 2020, the number of cases diagnosed per day had risen to 1126 (Figure 1B). The rapid rise in case numbers led the Dutch government to shut down primary and secondary schools, bars and restaurants, sporting facilities and other public spaces on March 15, 2020, followed by a more extensive shut-down of public life in the weeks that followed (see Figure 1A for major events). However, the three northern Dutch provinces did not follow national trends. COVID-19 appeared later here and didn't reach the same incidence of cases or infection rates. While the three northern provinces account for 10% of the Dutch population, they only had 2-3% of cases, hospitalizations and deaths in the period from February 27–June 9, 2020 (see Figure 1C; Supplementary table 1). Multiple factors may explain why the outbreak was different in the North [4][5]. Drenthe, Groningen and Friesland together are the least-populated region of the Netherlands and contain the fewest urban centres. The early arrival and spread of infection in the southern Dutch province of North-Brabant seems to have originated in travel to and from Northern Italy during the school holidays from February 22–March 1, 2020, with the spread of the infection in the southern Dutch region then further facilitated by personal contact during regional carnival celebrations. In contrast, school holidays fell earlier for the Northern provinces (February 15–22, 2020), which suggests that northerners who travelled to Italy during the vacation had returned before the major expansion of the outbreak in Northern Italy [6]. Nor is carnival widely or generally celebrated in the Northern provinces. Other factors may also have played a role, e.g. use of a stricter COVID-19 testing regime and wider availability of tests in the region [5]. The later arrival of COVID-19 to the North meant that the national steps taken to bring down the infection rate were in place before the outbreak had really taken hold in the Lifelines region.

Cohort Description

Participant recruitment. Participants of the Lifelines COVID-19 cohort are recruited from the Lifelines and LLNEXT cohorts. Lifelines is a prospective population cohort following ~167,000 people in the three Northern provinces of the Netherlands for 30 years [1] (see Figure 2 for Lifelines region). Established in 2006, Lifelines collects detailed information about its participants via extensive questionnaires and medical examinations, and the cohort has been shown to be representative of the Northern Dutch population [7]. By design, Lifelines recruited multiple participants within families to produce a multi-generational cohort that could map individual and community health across life-course [1]. Since 2016, LLNEXT has been recruiting an additional generation through inclusion of mother-baby pairs, with partners also invited to participate to generate parent-baby trios [2].

To recruit participants for the Lifelines COVID-19 cohort, Lifelines and LLNEXT invited their participants digitally to fill out the questionnaires. In each questionnaire round (Q1-Q7 in Figure 1D, Figure 3), all Lifelines participants over the age of 18 with a known email address received a link to the digital COVID-19 questionnaire (see inclusion flowchart in Figure 3). Digital invitations were valid for three weeks, and the date on which the questionnaire was completed was registered. Since LLNEXT is an ongoing project in which new participants are still being included, the number of LLNEXT participants invited to participate in the COVID-19 cohort increased with each new questionnaire round. In each round, invited participants chose if they want to fill in the questionnaire, and the cohort population consists of all those who filled in at least one questionnaire in the first seven questionnaire rounds (Figure 1D, Figure 3).

On March 30, 2020, all Lifelines and LLNEXT participants were invited to participate in the first COVID-19 questionnaire round (Q1 in Figure 1D, Figure 3), with new invitations to participate sent out weekly. Starting April 27, 2020, an additional questionnaire about children's health and symptoms was sent to the participants of the LLNEXT (>300 participants). Program questionnaires were sent out weekly through the week of May 18, 2020, then at bi-weekly intervals until July 2020, when the questionnaires

became monthly. The project has continued through 2020 and early 2021, with the option to increase questionnaire frequency when the local caseload begins to increase rapidly. While the timeline of the questionnaire program will be decided by the outbreak, the cohort itself will continue to exist as part of Lifelines, which will allow participants to be monitored for the long-term health impacts of the pandemic through the length of the Lifelines program.

Questionnaire contents. The Lifelines COVID-19 questionnaire includes question modules about socio-demographic parameters, chronic diseases, COVID-19 infection, general health and symptoms, medication use, the mental health/well-being of participants and of children and young adults in their family, corona-related well-being, social life, social relations and lifestyle (see Table 1 for modules and questions and https://www.lifelines.nl/researcher/data-and-biobank/wiki). For participants who answer a subsequent version of the questionnaire, these questions are related to their experience in the period since the previous questionnaire. Additional questions and question modules have been added as the questionnaire program progressed, including the Groningen Frailty Indicator [8], KIDSCREEN-10 [9] and the Positive and Negative Affects Schedule [10].

Lifelines COVID-19 cohort data can be linked to other participant data held by Lifelines, including detailed biological measurements such as genotype, metagenomics, metabolomics and transcriptomics collected for sub-cohorts within Lifelines such as Lifelines DEEP [11] and Lifelines DAG3. Data can also be linked to the administrative records held by Statistics Netherlands (https://www.cbs.nl/en-gb), which include health-related records on mortality, hospital admissions and healthcare costs, as well as data on employment status, income, wealth and other socio-demographic characteristics. Data can also be linked to drug prescription data held by IADB.nl via the Pharmlines initiative [12] and to SARS-CoV-2 testing data (including serological data) held by Certe and other Dutch laboratories.

Participant and public involvement. Projects carried out within Lifelines are discussed with the Lifelines Participant Advisory Board. With respect to the COVID-19 cohort, compiled questionnaire results have been continuously updated after each questionnaire round and shared with participants and the public through interactive infographics on the Corona Barometer website (https://coronabarometer.nl/, snapshot in Figure 4), as well as via frequent social media posts, press releases and interviews in the national press. Subsequent questionnaires have also been modified and refined in response to questions from participants. In addition, new questionnaire modules have been added based on the results of previous rounds and to examine the effects of changes in national policy.

Findings to date

Response rates and characteristics of respondents. In every questionnaire round, 139,679 out of 159,482 current adult Lifelines participants are invited to respond to the COVID-19 questionnaire. In total, 71,992 (51.4%) Lifelines and LLNEXT participants responded to at least one of the first seven questionnaires, and response rates ranged from 33-39% (42,917-54,525) (Figure 3). Compared to non-invited subjects (those without a known email address), invited subjects are younger, slightly more often female, have a lower BMI and are more often never smokers (Table 2). Of the 139,679 Lifelines participants invited, 71,833 (51%) completed at least one of the questionnaires in the first eight weeks of the programme. Compared to non-responders, these responders were slightly older, slightly more often female, had a higher BMI, were less often current smokers and more often ex-smokers (Table 2). While Lifelines as a whole has been shown to be representative of the regional population [7], these slight differences in cohort makeup should be considered when looking at data from the COVID-19 cohort.

For LLNEXT, 321 people were invited to participate in the first eight weeks of the project, and 159 participated (49.5%) (Table 3). Compared to invitees, respondents were more likely to be female (73.5% of respondents versus 50.5% of invitees) (Table 3). As LLNEXT recruits women who are currently pregnant, the age range was small and did not differ substantially between invitees, respondents and

non-respondents. In LLNEXT, 80% of all parents who responded to the main Lifelines COVID-19 questionnaire also returned data on their children for the LLNEXT-specific module on COVID-19 and its impact on children. In total, we have data for 112 children up until week eight of the COVID-19 questionnaire initiative: 96 children 0-3 years of age, 14 children 4-7 years of age and two children in the 8-18 age group.

COVID-19 cases. Of the participants who responded in the first eight weeks of the project, 1,294 (1.8%) responded that they had been tested for COVID-19, and 127 (0.2%) tested positive. In addition, 887 (1.3%) respondents said they had been told by a doctor that they probably had COVID-19, while 5,271 (7.3%) participants responded that they thought they had had COVID-19.

Early results and on-going projects. One of the earliest results of the project was a clear signal that feelings of loneliness and isolation were substantially stronger in individuals who lived alone and that this effect was strongest in the youngest age group of respondents (18-30 year olds, see corresponding panel in Figure 4). There was also an increase in the number of unemployed respondents who reported losing their jobs due to the crisis, rising from 7.5% of unemployed respondents to the first questionnaire round (Q1) up to 14% by the week 5 questionnaire (Q5). More recent results have shown that by the end of May 2020, as the number of infections and hospitalizations dropped to low levels and schools and business reopened, respondents were reporting less anxiety, better sleep and fewer worries about losing their jobs.

The data collected from the Lifelines COVID-19 cohort is currently being analysed to address the four goals of the project. COVID-19 cases reported by participants are being used to track the outbreak, and the symptoms reported by participants are being used to generate a symptom-based COVID-19 prediction model [13]. The data on chronic diseases, medication use and environmental factors (e.g. cohabitation or smoking) will be used to look for associations with SARS-CoV-2 susceptibility and COVID-

19 severity to help identify risk factors, protective factors and comorbidities. While factors such as age, sex, BMI and certain chronic illnesses have been associated with a more severe COVID-19 and higher mortality [14], there have also been questions about whether recent vaccinations can be protective [15][16], and cohort data should help address this. Important questions about why pregnant women and children seem to be relatively protected will also be analysed. Finally, it will be possible to look at genetic factors in detail as ~18,000 of the 71,922 COVID-19 participants who completed at least one questionnaire have been genotyped through the UMCG Genetics Lifelines Initiative (UGLI). Next steps include identifying participants who were also participants in the Lifelines cohorts for which we have more detailed data, e.g. participants with gut microbiome data, currently available for >10,000 Lifelines participants.

Mental health problems are known to increase in times of physical and psychological distress. The current COVID-19 pandemic is accompanied by strict government measures of social distancing and quarantine. As these events place significant stress on society and increase isolation and loneliness, close monitoring of mental well-being is important for both short- and long-term public health policies and individual-level care. Alertness in clinical systems and tailored mental health care may be needed during and after such a mass traumatic event. The data from the Mini International Neuropsychiatric Interview major depressive disorder (MD) and general anxiety disorder (GAD) [17] modules and the societal impact modules of the questionnaire will allow researchers to i) longitudinally track the prevalence of symptoms and diagnoses of MD and GAD during the pandemic in the Lifelines and LLNEXT populations, ii) associate symptoms with COVID-19 severity and outcome, iii) identify at-risk groups and individuals and iv) measure the impact of government policies on the overall mental health in the cohort.

The questionnaire will also help address the major impact the pandemic has had on the working lives of people in the Netherlands. Healthcare workers are a particularly vulnerable group due to their higher risk of being infected by SARS-CoV-2, and their working conditions during the height of infections

included long work hours, cancelled holidays, adverse physical and psychosocial work conditions, i.e. high psychological and emotional demands and low control [18][19]. These working conditions, together with moral distress in relation to the family situation, may increase the risk for mental health problems and sickness absence in this female-dominated occupational group with a high baseline risk. Other "essential" occupational groups are experiencing unprecedented changes in their working environments that may affect their physical and mental health as well as their labour market attachment. For many "non-essential" occupational groups that are now encouraged to work from home, the home working environment might not be suitable, and many families now have to combine working from home with caring for children. This will likely impact the productivity and quality of their work and their level of stress.

The lockdown has led to a sudden disruption of the economy, with several economic sectors effectively brought to a standstill. The Lifelines COVID-19 questionnaire is monitoring changes in people's current work situation by asking if they lost their job because of the crisis, if they are working in an essential job, and whether they have to work from home. The answers to these questions will be used to monitor both the impact of the crisis on the short- and longer-term labour market and to identify workers most at risk of losing their job. This is essential information for policymakers to be able to target measures to the most vulnerable groups in society and mitigate the financial impact of the crisis.

Strengths and Limitations

One of the main strengths of this cohort is its embedding within the long-running Lifelines prospective population cohort, which provides a rich data background about participants and the knowledge, infrastructure and relationship with participants necessary to recruit and engage participants during an evolving crisis. The high and sustained rate of response and the weekly questionnaires mean that the cohort can provide a detailed longitudinal prospective view of both the outbreak and the long-term impacts of the crisis. Another strength is the collaboration of researchers across a range of disciplines in

designing and implementing a questionnaire that can be used to address a wide range of research questions, can have immediate impact on policy and can be used to help design new policies to prevent and/or manage renewed outbreaks. Finally, Lifelines will continue to follow its participants for the coming decade and beyond, providing opportunities to examine the long-term health impacts of SARS-CoV-2 infection and of the pandemic.

The Lifelines COVID-19 questionnaire was also designed to make comparisons with similar projects throughout Europe. Direct cross-national comparisons with projects in Denmark and France are possible, as they are using nearly identical questionnaires, and will provide unique opportunities to examine the effects of different governmental measures on mental health and well-being. The cohort is part of COVID-MINDS network of longitudinal studies on the global mental health impact of Covid-19 (https://www.covidminds.org/) [20], and the Lifelines COVID-19 project is also participating in the COVID-19 Host Genetics Initiative [21], an international collaboration to share and analyse data to identify the genetic determinants of SARS-CoV-2 susceptibility, COVID-19 severity and outcomes. In addition, the Lifelines COVID-19 questionnaires have been requested by other (inter)national researchers as basis for designing their own questionnaires, e.g. separate research has been done on the experiences of COVID-19 patients, making use of the Lifelines COVID-19 questions.

The timing and nature of the COVID-19 outbreak in the Northern Netherlands, which diverged from that in other parts of the country, is both a strength and a limitation. The relatively low number of cases in the region, even accounting for undiagnosed cases, may seem to pose difficulties for statistical association analyses looking at COVID-19–related factors. However, as of June 2020, >800 participants reported having had COVID-19, as confirmed by a positive test or a doctor's diagnosis, which permits a wide number of statistical association analyses. Moreover, the impact of the societal steps taken to reduce the rate of infection in more heavily impacted regions of the Netherlands and the impact of the

associated economic crises should have similar psychological and social impacts in the Lifelines population. The fact that the initial outbreak in the North was effectively capped by public health steps now puts the questionnaire programme in an interesting position to monitor the immediate health and societal impacts of the lockdown measures and the impact of coming out of lockdown. It also lays the groundwork for steps to be taken if there is a resurgence of COVID-19 infections, and the data generated while local infection rates were low could work as baseline values if subsequent outbreaks in the Northern provinces are more intense.

Data sharing

The data analysed in this study was obtained from the Lifelines biobank, under project application number ov20_0554. Researchers interested in using this data should contact the Lifelines Research Office (research@lifelines.nl).

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Conflict of interest

The authors declare no conflict of interest.

Informed consent

All Lifelines and Lifelines NEXT participants have provided informed consent that provides the opportunity for add-on research.

Research involving human participants

Both the Lifelines and the Lifelines NEXT studies were approved by the ethics committee of the University Medical Center Groningen.

Contributorship statement

CW, JD, JOM, HMB and LF conceived and implemented the study. KM, PL, PD, HHW, JMV, APSO, SAJ, RW, IvB, FB, MXLD, JCH, AC, OB, EALM, UB, AZ, SAR, EZ, MS, SB, RvO, VA, LHD, AS, SAS, JD, JOM, HMB and LF contributed to the design and content of the questionnaire. PL, PD, HW, JMV, APSO, SAJ and RW carried out the data analyses, established the Corona Barometer website and provided all figures and tables. KM drafted the manuscript with contributions from PL, PD, HHW, JMV, APSO, SAJ, RW, IvB, FB, MXLD, JCH, AC, OB, EALM, UB, AZ, SAR, EZ, MS, SB, RvO, VA, LHD, AS, SAS, JD, JOM, HMB and LF. KM, PL, PD, HHW, JMV, APSO, SAJ, RW, IvB, FB, MXLD, JCH, AC, OB, EALM, UB, AZ, SAR, EZ, MS, SB, RvO, VA, LHD, AS, SAS, CW, JD, JOM, HMB and LF reviewed and edited the manuscript and approved the final version.

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Figures

Figure 1. Timeline of the COVID-19 pandemic in the Netherlands and Lifelines data collection. 1A. Important events of the pandemic in the Netherlands from February–June 2020. **1B.** Daily reported positive infections (grey) and hospitalizations (blue) visualized alongside the change in mobility (black) in the Netherlands. Mobility is quantified using Apple Maps Request data (https://www.apple.com/covid19/mobility) with the change over time normalized to February 1, 2020. Change in mobility indicates the percentage change in overall requested driving directions by users of Apple Maps. COVID-19 daily infections and hospitalizations are derived from the CoronaWatchNL github account (https://github.com/J535D165/CoronaWatchNL) and are based on reported numbers from the RIVM. **1C.** The reproductive number in the Netherlands and the three Northern provinces over time. The R(t) is calculated based on incident cases (new positive PCR tests) including healthcare workers and cases appertaining to local outbreaks. National and regional R(t) values in the early phase of the pandemic are not directly comparable, since testing among healthcare workers was more widely adopted early on in the Northern provinces. **1D.** Overview of the Lifelines COVID-19 data collections. The pie chart on the left shows the proportion of participants for each province. The first weekly COVID-19 questionnaire (Q1) was sent out on March 30, 2020. Based on Q1-7, 71,800 unique respondents have filled out at least one questionnaire. From Q7, assessments are biweekly.

Figure 2. Distribution of hospitalization across Dutch municipalities. The number of hospitalizations per municipality, as reported by the RIVM, were integrated with a geographical map of the Netherlands. For each municipality, the cumulative number of COVID-19 hospitalizations per 100,000 residents is shown. The Lifelines region is outlined in grey. This data was downloaded on May 18, 2020.

Figure 3. Study inclusion flowchart

Figure 4. Communicating COVID-19 cohort results to the public through the Coronabarometer. Snapshot of the Coronabarometer (https://coronabarometer.nl/), which is updated after every questionnaire round to present the most recent findings of the Lifelines COVID-19 questionnaire in a format accessible by the public. The website is now interactive to enable users to look at trends over time and compare variables.

Tables

Table 1. Lifelines COVID-19 questionnaire. Questions asked are modified slightly when respondents have filled in a previous questionnaire to indicate that they should answer with respect to the intervening period.

SOCIO-DEMOGRAPHIC		
Subject	**Question**	**Answer type**
Age	1	In the Lifelines database
Sex	2	In the Lifelines database
Location	3. What are the four numbers of the postcode of your home address?	Numerical field
Living situation	4. The following questions are about your household members who live with you **at least one day a week**.	
	4a1. How many household members are between 0-12 years of age?	Numerical field
	4a2. How many household members are between 13-18 years of age?	Numerical field
	4a3. How many household members are between 18-30 years of age?	Numerical field
	4a3a. How many household members are between 19-30 years of age?	Numerical field
	4a4. How many household members are between 30-59 years of age?	Numerical field
	4a4a. How many household members are between 31-60 years of age?	Numerical field
	4a5. How many household members are older than 60 years of age?	Numerical field
Effects Children	if 4a1 > 0 or 4a2 > 0	
	4b. Are your household members under 19 years of age your children or foster children?	Yes/ No/ Both
	if 4b = 'Yes' or 'Both'	
	4b1. Are your children (or child) experiencing stress about the corona crisis?	No stress / some stress / much stress / a lot of stress
	if 4b1 = 'some stress' or 'much stress' or 'a lot of stress'	
	4b1a. How do they show that?	Text field
	if 4b = 'Yes'	
	4b2. Do your children (or child) feel safe at home?	Safe / somewhat safe / unsafe / very unsafe
	4b3. Do your children (or child) feel safe in their neighbourhood?	Safe / somewhat safe / unsafe / very unsafe

Employment	5. What is your current work situation?	I am a student / I work (full-time, part-time, freelance) / I am disabled / I am unemployed / I am retired
	if 5 = 'I work'	
	5a. What kind of work contract do you have?	Full-time / Part-time / zero hour, flexible, on call / freelance
	5b. What is your current work situation?	I am working from home / I am being paid to work from home / I have been laid off work without pay / I continue to work at the usual location (e.g. office, factory, construction site) / I continue to work at multiple sites for my job / I have been forced to take sick leave or vacation time
	5c. Do you have a critical job? (As defined by the government)	Yes/No
	if 5b = 'I continue to work at the usual location'	
	5d. What is the location of your workplace? (postcode)	Numerical field
	if 5 = 'I am unemployed'	
	5e. Are you unemployed because of the Covid-19 crisis?	Yes/No
	if 5 = 'I work'	
	5f. Since the start of the Corona crisis in NL (mid-March), have you sometimes or regularly worked night shifts?	Yes, regularly / Yes, sometimes / No
	5g. Do you work in a profession in which you still come into frequent contact with patients, clients, children or the general public since the start of the corona crisis in the Netherlands (mid-March)? (For example, nursing, teaching, supermarket staff, police, emergency services etc.)	Yes/No
	4.1 Do you have any other household members? *This applies to anyone who lives with you* ***at least one day a week.***	Yes/No
	if 4a1 or 4a2 or 4a3 or 4a4 or 4a5 > 0	
	4c. Do any of your household members have a critical job? (As defined by the government.)	Yes/No
	4d. Does at least one of your household members work outside the house?	Yes/No
Weight	8a. What is your current weight (in kg)? If you have scale in the house, please weigh yourself.	Numerical field, kg
	8b. At what time of day did you weigh yourself?	morning / evening / I estimated my weight
Vaccinations	9. Did you get a flu shot in the past year?	Yes/No/Don't know
	10. Have you ever been vaccinated against tuberculosis? (BCG)	Yes/No/Don't know
	if 11='Yes'	

	10a. What year were you vaccinated against tuberculosis (give an estimate if not sure)?	Numerical field

CHRONIC ILLNESSES		
Subject	**Question**	**Answer Type**
Illness	1. Do you have a chronic health condition?	Yes/No
	1a. Cardiovascular disease (including high blood pressure)	
	1a1. High blood pressure	
	1a1. Heart attack	
	1a1. Narrowing of the arteries in the legs	
	1a1. Stroke or TIA	
	1a1. Other heart and/or coronary disease	
	1b. Lung disease, such as asthma, COPD or chronic bronchitis	
	1c. Liver disease	
	1d. Kidney disease or reduced kidney function	
	1e. Diabetes	
	1f. Chronic muscle disease	
	1g. Psychological illness, such as depression, psychosis or anxiety disorder	
	1h. Auto-immune illness, such as celiac disease, inflammatory bowel disorder, rheumatoid arthritis, lupus	
	1i. Cancer	
	1j. Neurological disease, such as dementia, Parkinson's disease or Alzheimer's disease	
	1k. Problems with your spleen (e.g. sickle cell anaemia, spleen removed)	
	1m. Do you have another kind of chronic condition?	
	1m1. Specify other condition	Text

COVID-19 RELATED	The following questions are about the period since the outbreak of the new corona virus.	
Subject	**Question**	**Answer type**
COVID-19	1a. Have you been tested for coronavirus (COVID-19)?	Yes/No

	if 1a = 'Yes'	
	1a1.Do you have or have you had a coronavirus/COVID-19 infection?	Yes/No
	1a1. What was the result of your corona virus (COVID-19) test?	Positive, I have a corona virus infection (COVID-19)/ Negative, I do not have a corona virus infection (COVID-19)
	if 1a = 'No'	
	1b. Has a doctor told you that you may have (or have had) a Covid-19 infection?	Yes/No
	1c. Do you also think you have (or had) a Covid-19 infection?	Yes/No
	if 1a1='Yes' or 1b ='Yes' of 1c ='Yes'	
	1d. Do you know how you got the infection?	Household family member / other family member / friends / co-workers / sport / other / unknown
	2a. Has someone you live with tested positive for a Covid-19 infection?	Yes/No
	2b. Has someone you live with been told by a doctor that they might have Covid-19?	Yes/No
	2c. Have you had contact with someone who tested positive for Covid-19? This means physical contact rather than by, e.g., telephone.	Yes/Not that I am aware of
	2d. In **the last 14 days** have you had contact with someone who tested positive for Covid-19? This means physical contact rather than by, e.g., telephone.	Yes/Yes, but I am a healthcare professional and used the appropriate personal protection equipment/Not that I am aware of
	2e. **Before filling in the previous questionnaire**, had you had contact with someone who has been diagnosed COVID-19 in the interval between then and now? This person either had symptoms at the time of contact or in the previous 24 hours, or they were diagnosed within a week after contact.	Yes/Yes, but I am a healthcare professional and used the appropriate personal protection equipment/Not that I am aware of
Hospitalization	if 1a1='Yes' or 1b='Yes'	
	3. Have you been hospitalized for a Covid-19 infection?	Yes/No
	Have you been hospitalized for a Covid-19 infection since the last time you filled in the corona virus (COVID-19) questionnaire?	Yes/No
	if 3 = 'Yes'	
	3a. Were you given supplemental oxygen?	Yes/No
	3b. Were you put on antibiotics?	Yes/No
	3c1. Were you in the intensive care unit of the hospital?	Yes/No
	if 3c1 = 'Yes'	

	3c2. Were you put on a ventilator?	Yes/No
HEALTH		
Subject	**Question**	**Answer type**
Overall health	1. How would you rate your health, in general?	excellent / very good / good / medium / poor
Recent symptoms	2. To what degree have you experienced the following symptoms **in the last 7 days:** *(Please fill in these answers even if the symptoms are chronic for you or you think you had them for reasons other than a corona virus infection)*	
	2a. Headache	not at all / a little / some / quite a lot / often
	2b. Dizziness	
	2c. Heart or chest pain	
	2d. Lower back pain	
	2e. Nausea or upset stomach	
	2f. Muscle pain/aches	
	2g. Difficulty breathing	
	2h. Feeling suddenly warm, then suddenly cold again	
	2i. Numbness or tingling somewhere in your body	
	2j. A lump in your throat	
	2k. Part of your body feeling limp	
	2l. A feeling of heaviness in your arms or legs	
	2m. Shortness of breath	
	2n. Pain when breathing	
	2o. Runny nose	
	2p. Sore throat	
	2q. Dry cough	
	2r. Wet cough	
	2s. Fever (38 degrees or higher)	

	2t. Diarrhoea or stomach pain	
	2t1. Diarrhoea	
	2t2. Stomach pain	
	2u. Loss of sense of smell or taste	
	2v. Red, painful or itchy eyes	
	2w. Sneezing	
	2x. Sensitive skin	
	2y. Pain in neck, shoulder(s) or arm(s)	
	2z. Upper back pain	
Fatigue	3. To what degree do you experience the following **in the last 7 days**:	
	3a. I felt tired	7 point NRS with left anchor “Yes, that's correct” and right anchor “No, that's not correct”
	3b. I got tired quickly	
	3c. I felt fine	
	3d. I felt physically exhausted	
Sex	4. Are you a woman between 18 and 55 years of age? *We do have this information in our database, but to ensure the rapid processing of this questionnaire, we are asking you to fill this in again.*	
	if 4=Yes	
Menstruation	4a. Did you menstruate in the last 7 days?	Yes / No / Prefer not to say
Doctor avoidance	5. **In the last 7 days** have you had health problems that you would normally see the doctor for, but chose not to contact your doctor?	Yes/No
	6. What best describes these symptoms?	1=Symptoms I had previously but haven't experience in a while, 2=Intensification of existing symptoms, 3=New symptom(s), 4=New psychological condition, 5=Symptoms fit with a corona infection, 6=Other
	7. Why did you choose not to contact your doctor? More than one answer is possible.	1=Symptoms not bad enough, 2=I got information elsewhere, 3=I started self-treatment, 4=I was anxious about contracting corona, 5=I did not want to bother my doctor, 6=Financial concerns, 7=No time, 8=Other (More than one option is possible)
MEDICATION		

Subject	Question	Answer type
	10. Has your medication usage changed since the last time you filled in the corona questionnaire? Don't forget to think about over-the-counter medications like cough syrup or paracetamol. If you're not sure, click 'Yes'.	Yes/No
	if 10 = Yes	
	Have you taken any medications **in the last 7 days**?	Yes/No
	Which medications have you taken **in the last 7 days**?	
	1. High blood pressure medicine (such as metoprolol, furosemide, enalapril)	Yes/No
	2. Inhaler	Yes/No
	3. Corticosteroids in tablet form (such as prednisone)	Yes/No
	4. Other corticosteroids (such as injections, hormone creams, eye or ear drops)	Yes/No
	5. Cholesterol lowering medication	Yes/No
	6. Diabetes medication	Yes/No
	7. Cough medicine	Yes/No
	8. Pain medication	Yes/No
	9. Other	Text
	if 1 = 'Yes'	
	Which blood pressuring lowering medications (e.g. metoprolol, furosemide, enalapril) have you used **in the last 7 days**? Multiple answers are possible.	Hydrochlorothiazide, Furosemide (e.g. Lasix®), Bumetanide (e.g. Burinex®), Atenolol, Metoprolol (e.g. Selokeen ZOC®), Bisoprolol (e.g. Emcor®), Captopril, Enalapril (e.g. Renitec®), Lisinopril (e.g. Zestril®), Nifedipine
	Other, specifically medicine 1:	Text
	Other, specifically medicine 2:	Text
	if 2 = 'Yes'	
	Which inhalers have you used **in the last 7 days**? Multiple answers are possible.	Salbutamol (e.g. Ventolin®, Airomir®), Formoterol (e.g. Oxis®, Foradil®), Salmeterol (e.g. Serevent®), Ipratropium (e.g. Ipraxa®, Atrovent®), Tiotropium (e.g. Spiriva®), Beclometasone (e.g. Qvar®), Budesonide (e.g. Pulmicort®), Fluticasone (e.g. Flixotide®), Foster®, Symbicort®, Seretide®

Other, specifically medicine 1:	Text
Other, specifically medicine 2:	Text
if 3 = 'Yes'	
Which corticosteroids (such as prednisone) have you used **in the last 7 days**? *Multiple answers are possible.*	Cortisone, Dexamethasone, Hydrocortisone, Prednisolone, Prednisone
Other, specifically medicine 1:	Text
Other, specifically medicine 2:	Text
if 4 = 'Yes'	
Which other corticosteroids (such injections, hormone creams or eye/eardrops) have you used **in the last 7 days**? *Multiple answers are possible.*	Injection with triamcinalonacetonide (e.g. Kenacort-A®), Salve or cream with triamcinolonacetonide, Nasal spray with triamcinolonacetonide (e.g. Nasacort®), Eardrops with triamcinolonacetonide, Salve or cream with hydrocortisone, Salve or cream fluticasone (e.g. Cutivate®), Salve or cream with betamethasone, Salve or cream with dexamethasone, Eyedrops with dexamethasone, TriAnal®
Other, specifically medicine 1:	Text
Other, specifically medicine 2:	Text
if 5 = 'Yes'	
Which cholesterol lowering medications have you used **in the last 7 days**? *Multiple answers are possible.*	Simvastatin (e.g. Zocor®), Atorvastatin (e.g. Lipitor®), Fluvastatin (e.g. Lescol®), Rosuvastatin (e.g. Crestor®), Pravastatin, Gemfibrozil (e.g. Lopid®), Cholestyramine (e.g. Questran®), Ezetimib (e.g. Ezetrol®), Inegy®
Other, specifically medicine 1:	Text
Other, specifically medicine 2:	Text
if 6 = 'Yes'	
Which diabetes-related medications have you used **in the last 7 days**? *Multiple answers are possible.*	Insulin (e.g. Novorapid®, Novomix®, Insulatard®, Mixtard®, Lantus®), Metformin, Tolbutamide, Glibenclamide, Gliclazide (e.g. Diamicron®), Pioglitazone (e.g. Actos®), Repaglinide (e.g. NovoNorm®), Acarbose (e.g. Glucobay®), Sitagliptine (e.g. Yesnuvia®)
Other, specifically medicine 1:	Text
Other, specifically medicine 2:	Text
if 7 = 'Yes'	
Which cough medicines have you used in **the last 7 days**? *Multiple answers are possible.*	Codeine, Noscapine, Broomhexine, Althea syrup or thyme syrup, Dextromethorphan, Pentoxyverine, Acetylcysteine, Carbocysteine, Promethazine, Chamomile or menthol

	Other, specifically medicine 1:	Text
	Other, specifically medicine 2:	Text
	if 8 = 'Yes'	
	Which pain killers have you used **in the last 7 days**? *Multiple answers are possible.*	Paracetamol (acetaminophen), Ibuprofen (e.g. Brufen®), Acetylsalicylic acid (e.g. Aspirin®), Diclofenac, Naproxen (e.g. Aleve®), Codeine, Tramadol (e.g. Tramal®), Oxycodone (e.g. OxyContin®, OxyNorm®), Morphine (e.g. MS Contin®, Oramorph®)
	Other, specifically medicine 1:	Text
	Other, specifically medicine 2:	Text
	if 9 = 'Yes'	
	9a. How many other different medicines have you used **in the last 7 days**? (*maximum 10*)	Text

MENTAL HEALTH AND WELL-BEING

Subject	Question	Answer type
MINI - Depression	1. In **the last 7 days** have you felt low or depressed for much of the day, every day?	Yes/No
	2. In **the last 7 days** have you had the feeling that you've lost interest in or the will to do things you are normally interested in?	Yes/No
	3. The following questions are about your experience in **the last 7 days**:	
	3a. Did your appetite change noticeably, or did your weight increase or decrease without this being intended?	Yes/No
	3b. Have you had problems sleeping almost every night (difficulty falling asleep, waking up in the night or too early in the morning, or actually sleeping too much)?	Yes/No
	3c. Did you speak or move more slowly than normal? Or did you feel restless, jittery and could barely sit still? Nearly every day?	Yes/No
	3d. Did you feel worthless or guilty almost every day?	Yes/No
	3e. Was it difficult to concentrate or make decisions almost every day?	Yes/No
	3f. Have you considered hurting yourself, wished you were dead, or had suicidal thoughts?	Yes/No
MINI - Anxiety	4. In **the last 7 days**, have you been worrying excessively and worrying about multiple problems of everyday life, at work, at home, in your immediate environment?	Yes/No
	if 4='Yes'	
	4a. Were these worries present almost every day **in the last 7 days**?	Yes/No
	4b. **In the last 7 days** did you find it hard to set these worries aside or did they prevent you from concentrating?	Yes/No

	5. **In the last 7 days** did it often happen that…	
	5a. You felt restless, jittery or nervous?	Yes/No
	5b. You felt tense?	Yes/No
	5c. You were particularly irritable?	Yes/No
CORONA RELATED WELL-BEING		
Subject	**Question**	**Answer type**
Pandemic worries	1. How much have you been concerned about the corona crisis in the past 7 days?	1=not concerned, 10=extremely concerned
	2a. I worry about getting sick myself	Never / almost never / sometimes / frequently
	2b. I worry that someone close to me will get sick	/ always or almost always
	2c. I am concerned that I or my family will be in serious financial trouble	
	2d. I worry that I will lose my job	
	2e. I worry that it will be a long time before my life returns to normal	
	2f. I am concerned that I can't see friends and family	
	2g. I am worried for another reason	
	if 2g = 'sometimes/frequently/always or almost always'	
	2g. For what other reason are you worried?	Text
Infection precautions	3. What precautions are you taking to prevent the spread of the coronavirus?	Frequent hand washing / Use of hand disinfectant / Social distancing (except for household members) / Social distancing, including household members / Covering my mouth and nose in public / Avoiding public transport / Reduced travel / Other, specifically...
	if 3 = 'Other, specifically...'	
	3_txt. What other precautions are you taking to prevent the spread of the coronavirus?	Text
Information sources	4. Where have you been getting your information and advice from **in the last 7 days**?	Media (Newspaper, TV, radio) / Health authorities (e.g. government, RIVM, WHO) / Social media (e.g. Facebook, twitter, instagram) / Family and friends / Others
	if 4 = 'Others, specifically...'	

	4_txt. Where else have you been getting your information and advice from **in the last 7 days**?	Text
Perceptions	5. Covid-19 threatens everyone in the Netherlands. 6. Since the beginning of the Covid-19 crisis, I see others in my area, such as people in the neighbourhood or in shops, as a threat to my well-being. 7. I have faith in the Dutch government's response to the corona crisis.	1=totally disagree, 2=disagree slightly, 3=neutral, 4=agree slightly, 5=totally agree
Corona proximity	8. Does someone close to you have a Covid-19 infection?	Yes/No
	9. Has someone close to you died of a Covid-19 infection?	Yes/No
Quality of life	10. How would you rate your quality of life **over the last 7 days**?	1= terrible, 10=excellent

SOCIAL LIFE

Subject	**Question**	**Answer types**
Social isolation	1. How socially isolated have you felt **in the last 7 days**?	1=not socially isolated, 10=extremely socially isolated
Loneliness	2. Can you tell us about how you felt **in the last 7 days?**	
	2a. How often do you feel excluded?	Almost never or never/ sometimes/ often
	2b. How often do you feel isolated from others?	Almost never or never/ sometimes/ often
	2c. How often do you feel alone?	Almost never or never/ sometimes/ often

SOCIAL RELATIONS

Subject	**Question**	**Answer type**
	Can you indicate how much you agreed with the statements below **in the last 7 days**?	
	1. I feel connected to all Dutch people	1=totally disagree, 2=disagree slightly, 3=neutral, 4=agree slightly, 5=totally agree
	2. I feel connected to my neighbours, family and/or friends	
	3. I get the help and support I need from my neighbours, family and/or friends	
	4. I do everything I can to help others who are infected with Covid-19	
	5. I expect that others will do everything they can to help me if I get infected or ill with Covid-19	
	6. I do not feel obliged to comply with the government's corona measures	
	7. I feel excluded by society	

	8. I feel that I am not appreciated by others in society	
	9. I am frustrated with how things are now going in society	1=absolutely not, 7=very much
	10. I am afraid that things will go wrong in our society	1=absolutely not, 7=very much

LIFESTYLE CHANGES		
Subject	**Question**	**Answer types**
Eating patterns	1. How healthy are you eating compared to the period before the Covid-19 crisis?	1=Much less healthy, 2=less healthy, 3=just as healthy, 4=healthier, 5=much healthier
	2. How often do you eat per day?	1=Less than 3x per day, 2=3x per day, 3=4x per day, 4=5x per day, 5=6x per day, 6=7x per day, 7=8x per day, 8=more than 8x per day
	3. How important do you think healthy eating is compared to the period before the Covid-19 crisis?	1=Much less important, 2=Less important, 3=Just as important, 4=More important, 5=Very important
Exercise	4. Before the corona crisis, how many minutes of (relatively) intense activity did you do each week (e.g. walking, biking or running)?	1=less than 50 mins, 2= 50-100 mins, 3=100-150 mins, 4= 150 -180 mins, 5= more than 180 minutes
	5. In the last **7 days**, how many minutes of (relatively) intense activity did you do (e.g. walking, biking or running)?	1=less than 50 mins, 2= 50-100 mins, 3=100-150 mins, 4= 150 -180 mins, 5= more than 180 minutes
	6. I do muscle and bone strengthening exercises, such as Nordic walking, jumping rope or weight training:	1=More than in the period before the Covid-19 crisis, 2=Just as much as in the period before the Covid-19 crisis, 3=Less than in the period before the Covid-19 crisis
Smoking	7. Have you smoked in the last 7 days?	Yes/No
Alcohol	8. Have you drunk alcohol in the last 7 days? If yes, how many units, on average?	0=0, 1=1 glass or "once',' 2=2 glasses, 3=3 glasses, 4=4 glasses, 5=5 glasses, 6=6 or more glasses
	8a. How many units of alcohol have you consumed in the last 7 days?	0=0, 1=1 glass or "once',' 2=2 glasses, 3=3 glasses, 4=4 glasses, 5=5 glasses, 6=6 or more glasses
	8b. How many units of alcohol have you consumed in the last 7 days total?	Fill in number, greater than 0, warning by 50
Activity levels	9. Before the corona crisis, how much time did you spend sitting, on average, per **working day** (Monday to Friday)?	Don't know, less than 1 hour, 1 hour, …, 12 hours, more than 12 hours
	10. Before the corona crisis, how much time did you spend sitting, on average, per **weekend day** (Sat, Sun)?	Don't know, less than 1 hour, 1 hour, …, 12 hours, more than 12 hours
	11. In the past 7 days, how much time did you spend sitting, on average, per **working day** (Monday to Friday)?	Don't know, less than 1 hour, 1 hour, …, 12 hours, more than 12 hours
	12. In the past 7 days, how much time did you spend sitting on average per **weekend day** (Sat, Sun)?	Don't know, less than 1 hour, 1 hour, …, 12 hours, more than 12 hours

COMMENTS	
Question	**Answer type**

1. Do you have any comments regarding this questionnaire?	Yes/No
if 1=Yes	
1_txt. What comments do you have about this questionnaire?	Text

GRONINGEN FRAILTY INDEX	For respondents 65 years of age and older.
Question	**Answer type**
1. Are you 65 or older? We do have this information in our database, but to ensure the rapid processing of this questionnaire, we are asking you to fill this in again.	Yes/No
2. Can you independently perform the following activities without any help from someone else, possibly with the help of a cane, walker or wheelchair?	Yes/No
2a. Get groceries and run errands	Yes/No
2b. Get dressed/undressed	Yes/No
2c. Move outdoors (around house, to neighbours)	Yes/No
2d. Go the toilet	Yes/No
3. What score would give your fitness (from 0 to 10):	Scale from 0 to 10
4. Do you have problems in everyday life due to poor vision?	Yes, many problems / Yes, some problems / No, no problems
5. Do you have problems in everyday life due to poor hearing?	Yes, many problems / Yes, some problems / No, no problems
6. Have you lost a lot of weight in the past period without wanting to (6 kg in 6 months or 3 kg in one month)?	Yes/No
7. Do you have memory problems?	No/Sometimes/Yes

KIDSCREEN	If household members are <18 years old (questions from the socio-demographic module).
Question	**Answer type**
How old is your oldest child aged 18 years or younger?	Number
Complete the following questions for this child for **the last 7 days**:	
1. Has your child felt fit and healthy?	Never / almost never / sometimes / frequently / always
2. Has your child felt full of energy?	

3. Has your child felt sad?

4. Has your child felt lonely?

5. Has your child had sufficient time for him or herself?

6. Has your child been able to do the things her or she wanted to do in their free time?

7.Has your child felt that he or she has been treated fairly by his/her parents?

8. Did your child have fun with his/her friends?

9. Did school activities go well?

10a. Has your child been able to pay attention?

10b. Has your child felt anxious?

10c. Has your child felt angry?

10d. Has your child been bored?

11. In general, how would your child rate his/her health? Excellent / very good / good / fair / poor

Table 2. Characteristics of adult Lifelines participants invited to participate in the cohort and the participants in COVID-19 questionnaire cohort during the first eight weeks of the project (Questionnaire rounds 1-7).

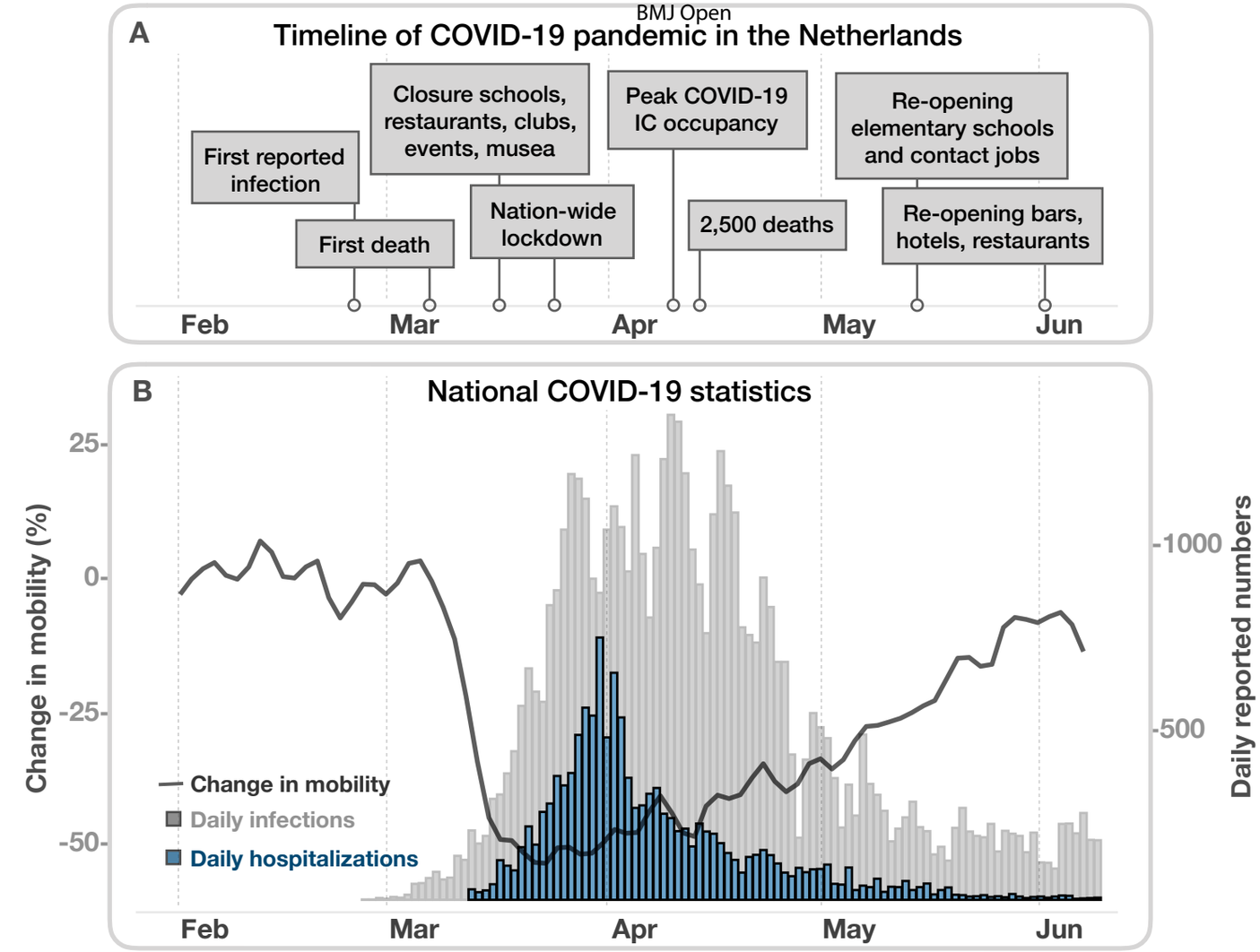
	Invited	Not invited	OR (95% CI)*	P-value	Responded	Not Responded	OR (95% CI)*	P-value
N (%)	139,679 (87.6)	19,803 (12.4)			71,833 (51.4)	67,846 (48.6)		
Current age, mean (sd)	51.1 (13.6)	57.8 (18.3)		< 0.01#	54.1 (12.9)	47.9 (13.6)		< 0.01#
Male sex, %	41.6	42.3	0.97 (0.95 – 1.00)	0.08*	39.2	44.2	0.81 (0.80 – 0.83)	< 0.01*
BMI at last visit, mean (sd)	25.9 (4.3)	26.5 (4.9)		< 0.01#	26.0 (4.3)	25.8 (4.4)		< 0.01#
Smoking at last visit, %								
never	52.1	46.1	reference		51.8	52.6	reference	
ex	32.1	37.4	0.76 (0.71 – 0.81)	< 0.01*	34.0	28.6	1.21 (1.17 – 1.25)	< 0.01*
current	15.8	16.5	0.85 (0.78 – 0.93)	< 0.01*	14.2	18.8	0.76 (0.73 – 0.80)	< 0.01*

* Odds Ratio (OR), 95% Confidence Interval (95% CI) and p-value using a logistic regression analysis.
# p-value using an independent T-test.

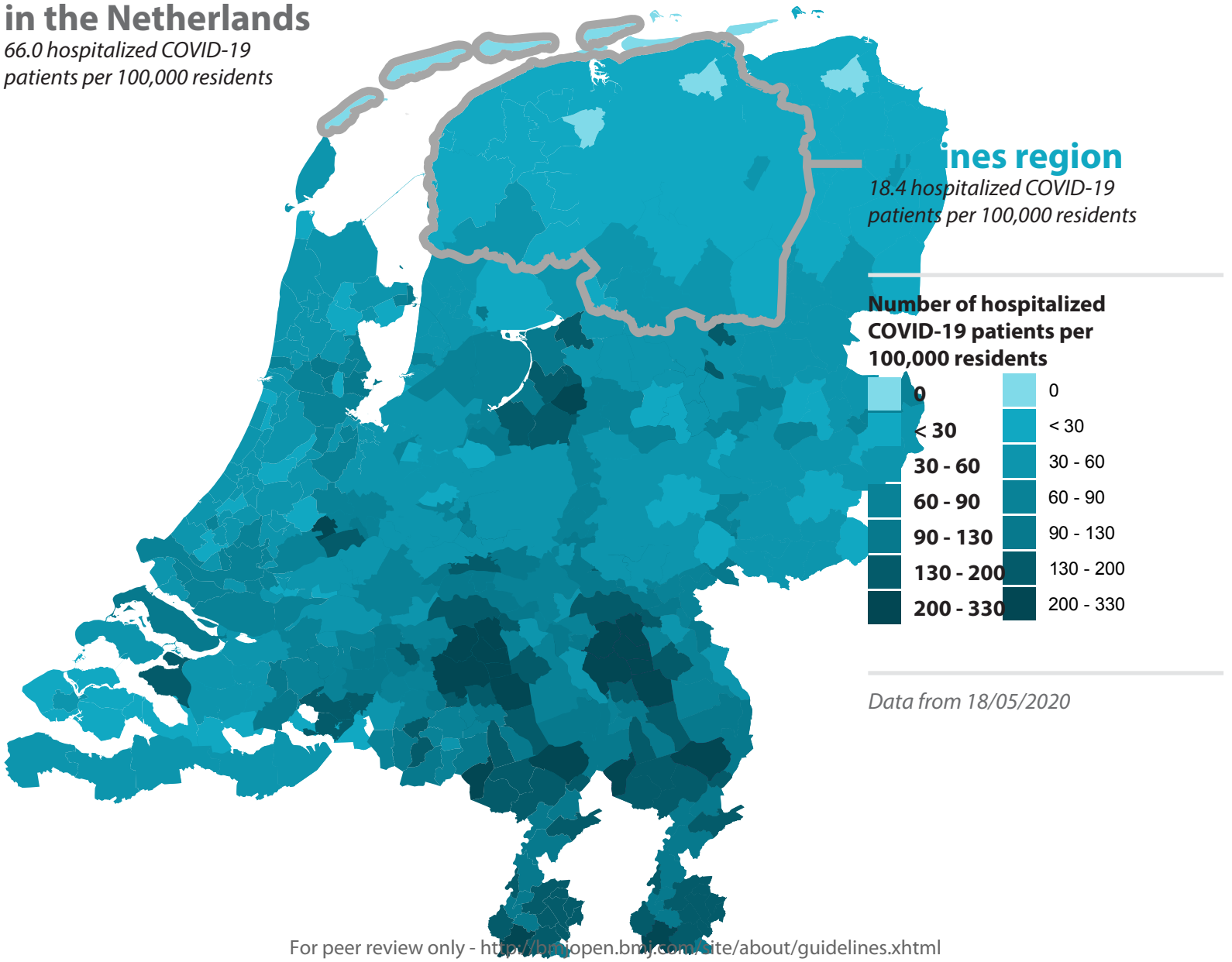
Table 3. Characteristics of Lifelines NEXT participants invited to participate in the cohort and the participants in COVID-19 questionnaire cohort during the first eight weeks of the project (Questionnaire rounds 1-7).

	Invited	Responded	Not responded	OR (95% CI)*	P-value
N (%)	321 (100)	159 (49.5)	162 (50.5)		
Current age, mean (sd)	33.6 (4.9)	33.0 (4.3)	34.3 (5.3)		0.01#
Male sex, %	49.5	36.5	62.3	0.35 (0.22 – 0.55)	< 0.01*

* Odds Ratio (OR), 95% Confidence Interval (95% CI) and p-value using a logistic regression analysis.
# p-value using an independent T-test.


A
Timeline of COVID-19 pandemic in the Netherlands
First reported infection
First death
Closure schools, restaurants, clubs, events, musea
Nation-wide lockdown
Peak COVID-19 IC occupancy
2,500 deaths
Re-opening elementary schools and contact jobs
Re-opening bars, hotels, restaurants
Feb
Mar
Apr
May
Jun
B
National COVID-19 statistics
Change in mobility (%)
25
0
-25
-50
-1000
-500
Daily reported numbers
Change in mobility
Daily infections
Daily hospitalizations
Feb
Mar
Apr
May
Jun
C
Reproductive number
Reproductive number (R[t])
6
4
2
0
The Netherlands
Northern provinces
R[t]=1
Feb
Mar
Apr
May
Jun
D
Lifelines COVID-19 data collection
Friesland
Other
Drenthe
Groningen
Q1
Q2
Q3
Q4
Q5
Q6
Q7
Ongoing
Unique respondents
60,000
40,000
20,000
Daily respondents
Apr
May
Jun

Hospitalized



Lifelines population cohort (n=167,729)

Lifelines NEXT birth cohort (n=689 babies and their parent(s))

All active participants aged >18 years with known email-address were invited to fill out weekly questionnaires (n=140,145)

Completed questionnaire #1 (n=54,525, response rate=39.0%)

Completed questionnaire #2 (n=51,988, response rate=37.2%)

Completed questionnaire #3 (n=50,356, response rate=36.0%)

Participants with invalid email-address were excluded (n=8,941)

Completed questionnaire #4 (n=47,334, response rate=36.2%)

Completed questionnaire #5 (n=45,483, response rate=34.8%)

Completed questionnaire #6 (n=42,917, response rate=32.8%)

Frequency of questionnaires was altered to bi-weekly

SMS campaign: participants provided correct email-address (n=1,670)

Completed questionnaire #7 (n=44,719, response rate=33.7%)

Lifelines COVID-19 cohort

71,992 unique participants responded to at least one of the first seven questionnaires

Participants who opened at least one email-invite were invited to fill out future questionnaires (n=111,239)

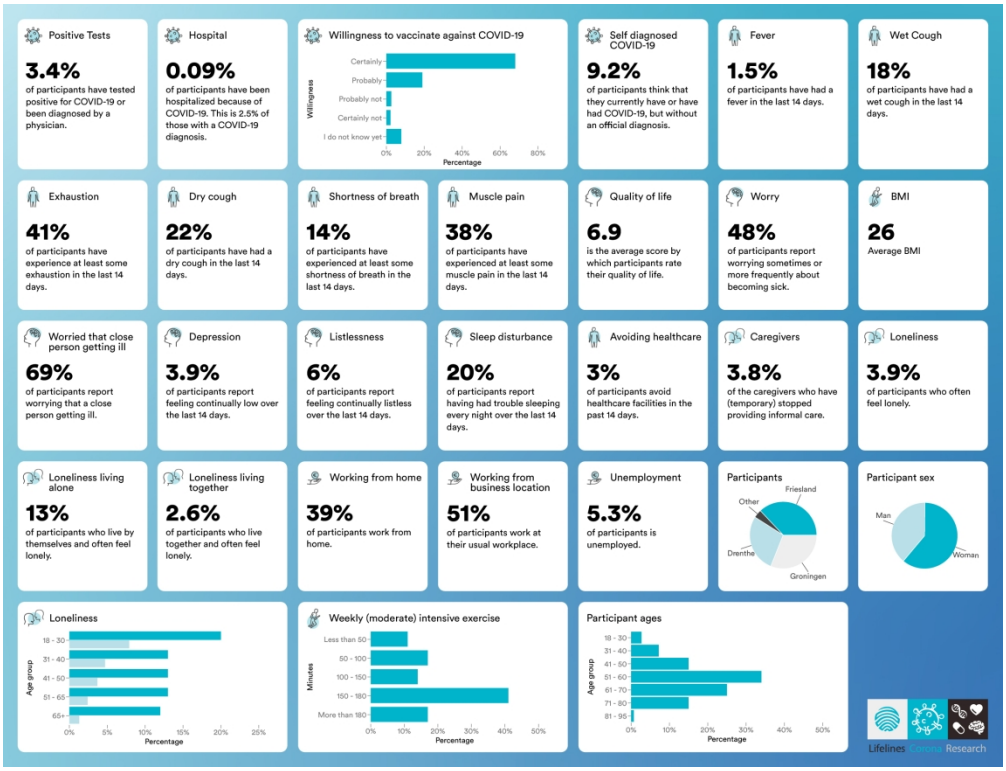


Figure 4. Communicating COVID-19 cohort results to the public through the Coronabarometer. Snapshot of the Coronabarometer (https://coronabarometer.nl/), which is updated after every questionnaire round to present the most recent findings of the Lifelines COVID-19 questionnaire in a format accessible by the public. The website is now interactive to enable users to look at trends over time and compare variables.

210x160mm (300 x 300 DPI)

Supplementary Table 1. Populations and COVID-19 infections, hospitalizations and deaths for the Netherlands as whole and for the Northern Provinces. Population values are as of January 1, 2020, retrieved from the Central Bureau Statistiek (https://opendata.cbs.nl/#/CBS/nl/dataset/03759ned/table; accessed July 10, 2020). COVID-19 statistics are as of June 09, 2020. Source: RIVM, downloaded from the CoronaWatchNL Github.

Region	Population	Infections	Hospitalizations	Deaths
Netherlands	17,181,084	47,903	11,800	6,031
North NL	1,729,505	1,491	320	122
Groningen	585,866	352	74	17
Friesland	493,682	616	130	65
Drenthe	649,957	523	116	40